RAILROAD GAZETTE

TIE SPACING AND RAIL BRACES.

In Mr. von Schrenk's study of tie shapes and tie spacing, in another column, he assumes that the heavier rail sections, being stronger as beams, may be supported with the same safety on fewer ties to the rail than are needed for the lighter sections. This is one of those things which ought to be but are not always true. On one road more than thirty 100-lb. Carnegie rails, supported on 18 ties, have broken during the past year. One break caused a bad accident, and in one other case there was a narrow escape from a fearful loss of life. If any engineer has succeeded in getting 100-lb. rail of as good, or anywhere nearly as good, quality as those of lighter weights we should be glad to be informed. Tie spacing, within reasonable limits, has little to do with the undertaking to get an unyielding support for the wheels. Careful observation of the movement of heavy wheel loads on rails from 80 lb. to 100 lb. shows no noticeable flexure between the tie supports. It often shows pronounced waves of depression, usually at the joints, but it not unfrequently happens that, with joint ties well tamped and with 6-bolt angle-bars bolted tight, the joint ties hold up and there is quite a uniform bending of the rail. The reason for this seems to be that a heavy angle-bar with the nuts newly tightened is quite a 100-per cent. joint, and that the three selected joint ties, set a little closer together than the others, can be made the high spot in the track. This is simply confirmation of the truth that, with track in good order, and within resonable limits of tie spacing, the measure of efficiency is the amount of timber bearing surface on the ballast. Mr. von Schrenk seems not to have made this point as clear as it should be; nevertheless, he arrives at an economical conclusion. He gets, from an 11½-in. diameter-stick a tie with a 10-inch base and a heart-wood upper surface of 6 in., which is a decidedly better tie than the 7 in. x 9 in. ordinarily hewed or sawed from the same sized log. He also gets three boards, a clean saving from the ordinary waste. He should have pointed out that, with ties so cut with 10-in. bases and laid 17 to the rail, he may have somewhat more bearing surface than with 7-in. x 9-in. ties laid 18 to the rail. This is a saving of 1-18 of the cost of ties and tamping, with quite equally good results.

One consideration, however, in reducing the number of ties under each rail seems to be ignored. The increasing equipment of freight cars with air brakes has introduced new track disturbances, and partially equipped freight trains, now so common, intensify them. The weights and speed have been largely and safely increased, but, when the brakes are applied to these huge trains on a curve, the side thrust is such as was not known a dozen years ago. With the present tie spacings, spreading track is not unusual, and the tendency is toward still higher freight-train speeds and heavier loads. Any reduction in the number of spikes, due to fewer ties, must surely be compensated on curves by rail braces or by tie plates designed to hold.

RAIL AUTO-CARS.

Many of the railroads in this country have much revenue adjacent to their tracks which has not yet been developed. That is to say, additional traffic could be obtained if links were built between railroad stations and outlying districts which need improved traveling facilities. The truth of this statement has been proved by the experiences of many through steam roads which have been benefited by interurban electric roads which act as feeders. In the early days of interurban electric competition, the steam roads sought to win back local traffic by cutting rates, but this procedure was soon found to be ineffective. Most steam road managers now realize, or should realize, that the most attractive features of the electric road are frequent service, high speed and accessibility to the passenger, and unless the steam road can offer these same advantages, the bulk of local traffic will continue to go to the interurban roads which use electric motor cars. The only hope for purely local steam roads is in electrification. Steam roads doing mainly through business have nothing to fear from local electric roads for the reasons before mentioned.

A good many attempts have been made by steam roads to duplicate the service of electric roads without the necessity of a large investment in electrical apparatus, overhead or third-rail construction, motor cars, etc. New and powerful steam locomotives have been tried and found wanting, as for example, on the Great Eastern of England. On a great many roads, especially in the western part of this country, there are branch lines on which passenger trains cannot be operated with profit. The high wages now paid enginemen and trainmen and the necessity of employing two enginemen and two or three trainmen even on a short train, makes the service too expensive. The alternative of the railroads has been either to take off the service entirely or to run a mixed service and the result is that the communities are grumbling and asking for electric roads.

With the above considerations in view it is quite evident that there is a field for a rail auto-car built on the principle of an automobile and run by steam or gasolene. The term "auto-car" is used to designate cars which generate their own power, from motor cars, which get power from overhead or third rail conductors. From an operating point of view the use of such cars would solve many troublesome problems, but so far, difficulties have been met in designing a car suitable for the service required. Auto-cars will probably never be designed which will be capable of competing with the electric interurban car, for at least 250 horse-power per car is required in order to get high acceleration and speed and at the same time have a little reserve power for climbing grades. In fact, most interurban electric cars have 300 horse-power or more in electric motors, and some have as high as 600 horse-power. The auto-cars so far designed have not had motors exceeding 100 horse-power. The North Eastern auto-car, which was described in the *Railroad Gazette*, April 29, last, has an 80 horse-power petrol motor driving a dynamo. The current thus generated is used in motors on the trucks. The petrol motor and dynamo take up about one-fifth the total length of the car and nearly all the width of the car, so that a larger motor could not well be used. If steam is used as motive power, the space occupied by the boiler and coal and water is large. Steam cars are used by the Great Western, London & South Western, Taff Vale and other foreign roads. They have also been tried in this country. Tests on the London & South Western car, which seats 46 passengers, show that the maximum speed of 25½ miles an hour is reached 55 seconds after starting.

It is quite possible that the development of the automobile will point the way to a rail auto-car which will work smoothly and economically at moderate speed. High speed and acceleration such as is possible by electric motor cars will undoubtedly never be possible with auto-cars. But there is a field for the auto-car even in its present state of perfection. There are many places where there are good-sized communities 10 or 15 miles from the nearest station of a steam road. It is this sort of revenue adjacent to the tracks that was referred to in the opening sentence of this article. By building short branch lines of light construction into such communities and running auto-cars at intervals to connect with main line trains enough traffic could no doubt be obtained to pay for the investment. In such cases the auto-car would take the place of the farmer's horse and wagon.

THE VALUE OF HEATING SURFACE

Mention has already been made in these columns of the desirability of making tests to determine the rate of evaporation in the fire-box and tubes of a locomotive boiler. Few tests of this sort have been made, and those carried out by M. Petiet, in 1865, are the most complete. But the apparatus which he used and the conditions under which the tests were made make his results of little value to-day. Of late years the necessity for accurate data on the subject has been particularly urgent, and it has been suggested that a sectional boiler be built so that the number and length of flues and the grate area, etc., can be varied and the rate of evaporation under each condition accurately measured. This process would, of course, give the desired results, but the apparatus would be costly and the large number of variables to be considered would increase the liability of error in the measurements.

In another column Mr. Lawford H. Fry suggests a method of making such tests on existing boilers by measuring only the quality of the fuel, the amount of the products of combustion, and the fall in temperature at intervals between the fire and the smoke-box. His analysis is based on fundamental principles and gives a scientific basis for making comparisons. The only difficult observation to make is the temperature of the gases in a tube at different points in its length. But this can be obtained by means of a thermal-electric joint on the end of a long pipe, which slips through a stuffing-box in the front of the smoke-box. This pipe need not be larger in diameter than about ¼ in. and the wires from the thermal-electric joint could pass through the pipe, thus

tric joint could pass through the pipe, thus protecting them from the hot gases. Graduations on the outside of the pipe at predetermined points would indicate the exact position of the thermal joint in the boiler tube. The thermal-electric joint and connections is similar in every respect to the Le Chatelier pyrometer, which is used in measuring high temperatures. The apparatus can be accurately calibrated and the temperature reading can be got with great accuracy. Of course, the presence of the pyrometer in the boiler tube would tend to obstruct the passage of the gases, but if made small, as suggested, the error on that account would no doubt be small enough to be disregarded.

The final equation deduced by Mr. Fry, giving the total evaporation of a boiler, involves only the grate-area and the heating surface. His analysis is based on the fundamental consideration that the heat is transferred from the grate to the water by direct radiation from the fire and by the products of combustion. The heat given off by direct radiation must be absorbed by the fire-box surface and the tube ends immediately adjacent to the fire-box. A part of the heat carried by the gases is, of course, given up to the fire-box sheets, but the greater portion passes on into the tubes. With a grate of given area producing a known quantity of heat per hour, it is possible to determine the proportion of radiated heat, which is all absorbed by the boiler. The amount of gas-carried heat absorbed depends on the extent of heating surface over which the gases pass. An interesting fact developed is, that in substituting good coal for medium coal, the increase in evaporation is due chiefly to the increase in the amount of radiated heat; for example, by using coal of 15,000 B. T. U. per pound instead of coal of 13,000 B. T. U., the total evaporation is increased about 35.6 per cent., while the actual heat at the grate is only increased 26.8 per cent. This may explain why some English locomotives give such high evaporative performances. Good Welsh coal frequently contains 15,000 B. T. U. per pound, whereas many American locomotives use coal having but 8,000 or 10,000 B. T. U. per pound.

WATER SOFTENING

In referring to the losses from bad feed water for locomotive boilers, in the excellent paper on "The Loose Ends in the Motive Power Department," a liberal extract from which was printed in these columns two weeks ago, the author says that a system of reservoirs to hold rain water, where good water cannot be obtained, is the only sure remedy. A few years ago this statement would probably have been accepted unreservedly; for although American roads excel in many ways, the question of chemically treating the feed water before it goes into the tank has remained in the background until the last few years. In Europe, water softeners have been a well-recognized factor in railroad economy for a long period, and in this country they are coming to be recognized as an operating necessity by roads having bad boiler water to contend with. Their use offers a remedy, equally, if not more, sure, and in many respects more practical and satisfactory than the one suggested above. By far the largest user of water softening plants in the United States is the Union Pacific Railroad, with 36 stations in operation or under way, the total capacity of which will be 3,000,000 gals. daily, and the presentation in another column of the economical results which have attended an improved quality of water supply, together with the expense for the operation of the softeners, furnishes a valuable and interesting contribution to the rather meager data on this comparatively new question in American railroad practice. As the paper states, the limited period for which comparative statistics are available at this time prevents their showing full value on many points, on some of which it will take considerable time, years perhaps, to realize fully the extent of the benefits derived; but of the figures given, the increase in average monthly engine mileage of 27 per cent. and the decrease in repairs to locomotives per engine mile of 34 per cent., are impressive. Washing out has been reduced 50 per cent. on all locomotives, with the exception of those engaged in one particular class of passenger service. The flue mileage of freight locomotives has been increased 150 to 200 per cent., and of passenger locomotives 400 per cent., while the effectiveness of each pound of coal put into the fire-box has been enhanced 7½ per cent. On the Union Pacific, for the four years ending June 30, 1902, the expense for repairs and renewals of locomotives was 10.19 per cent. of the total operating expense, while fuel for locomotives was 10.8 per cent., and the expense for engine and roundhouse men was 10.1 per cent., these three being the largest single items in the expense account. As each of these is directly and appreciably affected by the use of better water, the economic influence which a judicious and adequate use of treating plants exerts on total operating expense is obvious. Chief Engineer Berry, of the Union Pacific, in a statement made last fall regarding water softening on his road, said that the saving in boiler repairs alone warrants the outlay made for softeners; and after stating the cost of chemicals per 100 lbs. of incrusting solids removed he said: "Even though this figure were doubled, it would still be an economy, as any experienced man knows that 100 lbs. of scale cannot be removed from boilers for any such figure."

MACHINE SHOP BELTING.

One effect of electric driving in railroad machine shops has been a reduction in the amount of belting used. Nevertheless, the amount still used in a majority of modern shops is sufficient to affect the efficiency and the cost of operation, maintenance and repairs. A study of the belting system even in a new shop often shows where economies can be effected. When experts are called in to organize and systematize an existing shop, it is usual for them to ask for an invoice of all belting and for records showing the cost of maintenance, repairs and renewals. By properly classifying and tabulating these figures the high spots can be found and an effort made to get few interruptions to operation on account of failing belts. Where old belted tools using high-speed tool steel are used and are worked to the limit of their strength, unless it has been possible to increase the belt capacity—and this in many cases, probably a majority, is impracticable—the belts are overloaded and frequent interruptions occur. The time lost by a machine while waiting for belt repairs or renewals may be sufficient to more than offset the increased work obtained from heavier cuts and feeds.

Mr. F. W. Taylor in his well-known experiments on belting, found that the total life of belting, cost of maintenance and repairs and the interruptions to operation are dependent chiefly upon the total load to which the belts are subjected, more than upon any other condition. By total load is meant the total stress per inch of width, or square inch of section, on the tight side while in motion. He found that the average cost per double belt per year of service, including the original cost and cost of maintenance and repairs, was $6.72 when the belt is used under the ordinary rules of belting, viz., 111 lbs. total load per inch of width. Also the annual cost of maintenance, repairs and renewals averages per year about 37 per cent. of the original cost of the belt.

Other conditions named as chiefly affecting the durability of belts are (1) whether spliced, or fastened with lacing or some of the patent devices, (2) whether they are properly greased and kept clean and free from machine oil, and (3) the speed at which they run. The following table gives some recent experiments with new leather belting to determine its strength, and also the strength of different sorts of joints. The figures are per square inch of cross-section.

	Lbs.	Per cent.
To tear new double leather belt....	6.400	100
To tear the same belt at 5-in. splice.	5.680	90
To tear the same belt at riveted splice	3.800	60
To tear out (patent) spiral steel-wire joint with rawhide hinge...	2.700	42
To tear out brass wire lacing......	2.440	38
To tear out ordinary rawhide lacing.	2.250	35
To tear out brass studs...........	1.920	30
The rule of the Buckeye Engine Company for working tension of belt is	275	..
F. W. Taylor's rule, based on a minimum of interruption to operation.	200 to 225	

The range covered by these tests was limited and they cannot therefore be regarded as complete, nevertheless the results are interesting and useful. Ordinarily, a properly scarfed and cemented joint is considered as effective as any other part of the belt. In these tests this joint showed an efficiency of 90 per cent., and was 50 per cent. stronger than the next best joint. The efficiency of the best laced or wire joint (spiral steel wire with rawhide hinge) was 42 per cent. Brass studs were the poorest joints, showing an efficiency of only 30 per cent.

Mr. Taylor recommended, for maximum economy, a belt speed of from 4,000 to 4,500 f. p. m. and an average total load for double belting of 65 to 73 lbs. per inch of width, or 200 to 225 lbs. per square inch of cross-section. This load corresponds to an effective pulling power of 30 lbs. per inch of width. He found that belts yielding the most economical results were under a total load of 54 lbs. per inch of width, and an effective pull of 26 lbs. per inch of width, under which conditions the yearly service cost was $5.70, and the average cost of maintenance, repairs and renewals was 14 per cent. of the first cost. Proper attention to belting, especially where the system is large and complex, means increased efficiency and an appreciable reduction in the cost of operation.

The New York, New Haven & Hartford Railroad Company recently adopted a new

timetable, which makes no provision for stops by four express trains which heretofore have stopped at the city of Meriden, Conn., on the Boston & Albany route, between New York and the Massachusetts capital. Hence an outburst of wrath among the citizens of Meriden, a call by the President of the Meriden Board of Trade for a fund to bring the New Haven road to book in the courts, and repeated appeals to the Connecticut Railroad Commission to compel the abolition of grade crossings in the city, the slowing of trains which have not hitherto stopped at the Meriden station, and other plans of a more or less retaliatory and coercive nature. The anger of the Meriden folk is very likely justified, and certainly, in the nature of human nature, is the sort of thing to be expected, when a thriving New England city finds itself even qualifiedly side-tracked. But below the surface is a stratum of rich humor. For a good many years the Boston & Albany has been demanding from the New Haven faster time on through express trains, and the new timetable is a *quasi* concession to the demand. But what the New Haven really craves is the haul of all Boston-New York passengers on its own route by the Shore Line and Providence, where it has a trackage almost 100 miles longer than on the route *via* Springfield and the Boston & Albany. And, but for the demand for quick service by such cities as Meriden and Hartford, and Springfield, we venture the guess that most of the through express trains *via* Springfield would long ago have lapsed into desuetude. We can fancy, therefore, the equanimity with which the New Haven company contemplates any retarding policy of a Connecticut city on the "short haul" route, and that its Oriental calm would burst into positive glee if, for example, the Connecticut Commissioners should compel it to stop at every station between New Haven and the northern Connecticut State line. When Meriden openly, and the railroad corporation covertly, approve the "stop" theory on the Springfield route, we have not the least doubt that the Connecticut Railroad Commission will prove complaisant, and, in due season, a letter with regrets at having to "yield to authority," pass from President Mellen to the official head of the esteemed sister corporation.

TRADE CATALOGUES.

Arthur Koppel, 68 Broad street, New York, issues supplement No. 2 to catalogue No. 77. This supplement illustrates some types of Baldwin locomotives which are generally used for industrial purposes. An agreement has just been made between Arthur Koppel and the Baldwin Locomotive Works so that the former is now in a position to furnish Baldwin locomotives of all classes and sizes for any gage and for all kinds of motive power, including steam, electricity and compressed air. The last page of the catalogue is in the form of an inquiry sheet which may be filled out if estimates or specifications are desired.

Marshall & Huschart Machinery Co., Chicago and Cleveland, has issued a new catalogue containing illustrations and descriptions which the preface states covers only a portion of the various lines of machine tools and kindred devices the company carries in stock. This company represents 30 different makers of such machinery, including many of the most prominent in the country. The catalogue is 9 x 12, has 151 pages and is printed on heavy enamel paper, only one side of a leaf being used. The covers are board, bound in cloth.

The Stanley Electric Manufacturing Company, Pittsfield, Mass., is sending out a wall map of the S. K. C. system for long distance transmission in California. The points between which transmission has already been installed are marked on the map by means of full lines and those between which it is proposed to install the system are marked by broken red lines. The longest transmission at present is 232 miles from De Sabla to Sausalito. Ten thousand horse-power is being regularly delivered into San Francisco from the Electra-power station by way of Stockton and Mission, San Jose, a distance of 147 miles.

The Ingersoll-Sergeant Drill Company, 26 Cortlandt street, New York, publishes catalogue No. 35 in the form of a portfolio showing its standard types of air compressors. The book is fully illustrated with excellent half-tones and contains tables of dimensions with brief footnotes describing the main features of each machine. The photograph of the new works of the company at Phillipsburg, N. J., is also shown. These works are the largest of their kind in the world. Illustrations are also shown of the new electric-driven air compressor, a number of which have recently been installed by the St. Louis Transit Co. for a new system of storage air-brakes.

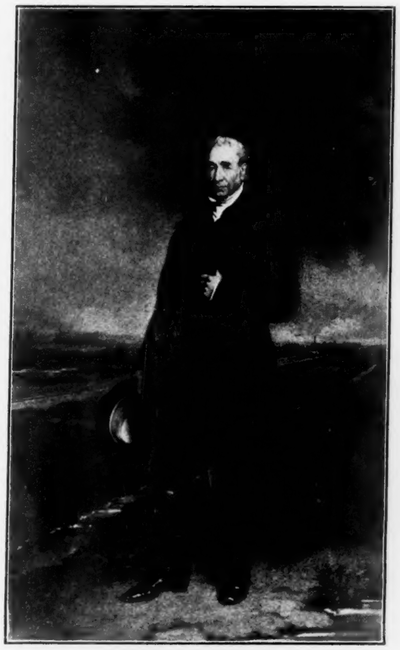
CONTRIBUTIONS

An American Memorial to George Stephenson.

29 Great George Street,
Westminster, London, S. W., June 8, 1904.

TO THE EDITOR OF THE RAILROAD GAZETTE:

A movement is now being made to establish an American memorial to George



George Stephenson, 1781-1848.

Stephenson, the British engineer and pioneer of railroads. Probably every American engineer knows of the heartbreaking difficulties that constantly faced him in his railroad work. The British landlords were against him, one of them saying that his ten-miles-an-hour locomotive would spread dismay among cattle plowing in the fields or grazing in the meadows, and the professional engineers at Westminster ridiculed his projects, calling them absurd; while his evidence was described as trash and confusion and he was called unstintedly an ignoramus, a fool, and a maniac. His Parliamentary bills to obtain rights to build the pioneer railroad were ignominiously thrown out in the first attempt, and it is said that this was the most severe trial he went through in the whole course of his life. It almost appears as if Nature herself was using her forces to prevent the success of a man who has perhaps contributed more toward the material well-being of more people than have all the emperors, military heroes, statesmen, and philanthropists from the beginning of time.

It is believed that the reason the United States has not acknowledged any part of the gratitude to George Stephenson is that no one so far has indicated a way in which this gratitude can find a suitable outlet. The creator of railroads lies in the little Church of Holy Trinity, in the town of Chesterfield, England. This Church of Holy Trinity has only a very small congregation, who are either poor, or, at the best, of very moderate means, and although the vicars of the church have for many years desired to extend the dimensions of the miserably inadequate chancel containing the grave of the illustrious railroad engineer, it has thus far been found difficult to secure the $10,000 required to effect the structural alterations. George Stephenson's grave is simply covered with a plain stone, in which are cut the engineer's initials.

It is now suggested that American citizens, especially those associated with railroad engineering, might care to make the construction of this proposed chancel and the provision for a fitting tomb their especial work to repay the depth of gratitude they owe to the illustrious dead. Those in sympathy with the memorial proposal are asked to send their communications to the address here given.

B. W. THWAITE, *A. M. Inst. C. E.*

Foreign Railroad Notes.

It is reported that April 30 for the first time the sound of the blasting explosions at one face of the Simplon Tunnel was heard at the other end, about ⅝ of a mile distant. During April 379 ft. advance was made at the north end and 575 ft. at the south end.

Certain Russian cities are allowed a tax on all freight shipped or received at their railroad stations, collected with the freight charges. This amounts to 1/5 kopek per pood, which is 1 cent for 360 lbs., or about 5½ cents per ton.

The pressure of military traffic on the Siberian Railroad has been such that the population of Siberia, small as it is, complains that it cannot obtain its usual supply of the goods which it imports from European Russia, and especially sugar is lacking. In consequence it has been ordered that such merchandise be forwarded first to the Siberian border, and there stored till opportunity is found to send it to its destination.

The Prussian State Railroads are in the market for 516 passenger cars, 120 baggage cars and 3,188 freight cars, to be delivered by the end of next March. Only works which have built cars for these railroads are permitted to bid.

A committee has been formed in Budapest to collect money for the relief of the families of railroad employes imprisoned or discharged in consequence of the late strike.

Four-Cylinder Balanced Compound for the Prussian State Railways.

The locomotive exhibited by the Hannoversche Maschinenbau Aktien-Gesellschaft of Linden-vor-Hanover at the St. Louis exposition is shown herewith. The Prussian State Railways have 29 of this type in use or building, 19 having been ordered this year. The engine is the four-cylinder balanced compound Atlantic type with von Borries simplified valve-gear and a Pielock superheater. The four cylinders are set in a line across the engine on the center line of the leading truck. The two high-pressure cylinders are between the frames and the two low-pressure cylinders are outside the frames. Each pair of high and low-pressure cylinders is cast in one piece with their corresponding steam chests. The two groups of cylinders are bolted together and carry the smoke-box. They rest on the frames, which are the bar type at the front of the engine and the usual plate form at the rear. The four pistons all drive on the forward axle. The cranks of the high-pressure and low-pressure cylinders on the same side of the engine are set at an angle of 180 deg. to each other. The reciprocating parts balance each other almost perfectly as will be seen by the following table:

	H. P.	L. P.
Piston, lbs.	78	156
Piston rod, lbs.	67	108
Cross-head, lbs.	152	152
Main rod, lbs.	244	182
Total	541	598

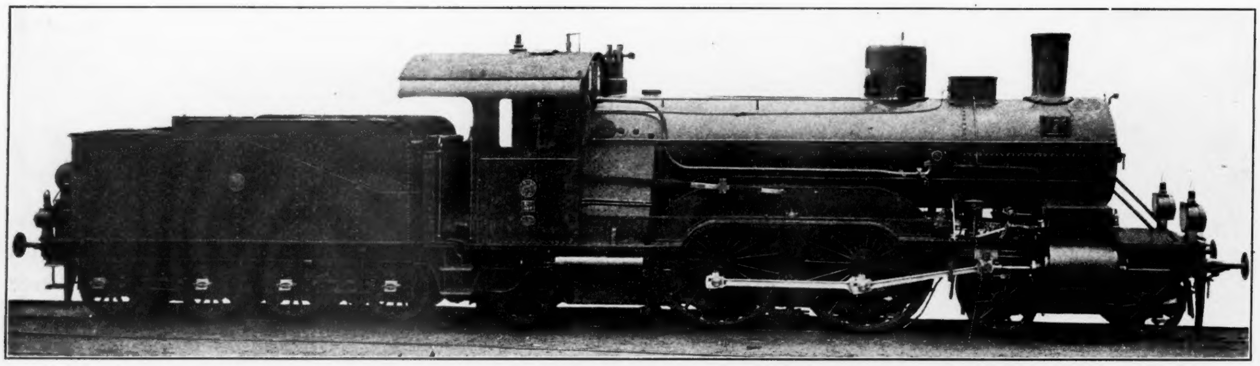
This arrangement of cylinders is the same as that employed by Mr. Vauclain for the Baldwin four-cylinder balanced compounds.

The valves of the high-pressure cylinders are the piston type with inside admission, and the valves of the low-pressure cylinders are the balanced Trick type. Both valves on one side of the engine are driven by a single gearing. The two valves are controlled by a single link which receives its motion from one eccentric, but the stem of each valve is coupled to a lever which receives its motion from the crosshead of the corresponding piston. The link movement is transmitted to the outside valve by a rod with levers of different lengths so proportioned that the ratio of steam admission is 55:30 for low-pressure and high-pressure cylinders in both forward and backward gear.

The cylinders of this engine are $14^3/_{16}$ in. and $22^1/_{16}$ in. x $23\frac{5}{8}$ in., and the drivers are $77^{15}/_{16}$ in. in diameter. The total weight of the engine in working order is 132,650 lbs., with 67,000 lbs. on the drivers. The weight on the trailing wheels is 26,630 lbs. The working steam pressure is 200 lbs. The total heating surface in the boiler is 2,019 sq. ft. divided up as follows: Tubes, 1,632 sq. ft.; fire-box, 108 sq. ft.; superheater, 279 sq. ft. The grate area is 29 sq. ft. The maximum tractive effort is 16,083 lbs., which is calculated by the following formula:

$$T = \frac{2\,d_1^2\,l\,p}{3\,D} + \frac{d_2^2\,l\,p}{4\,D}$$

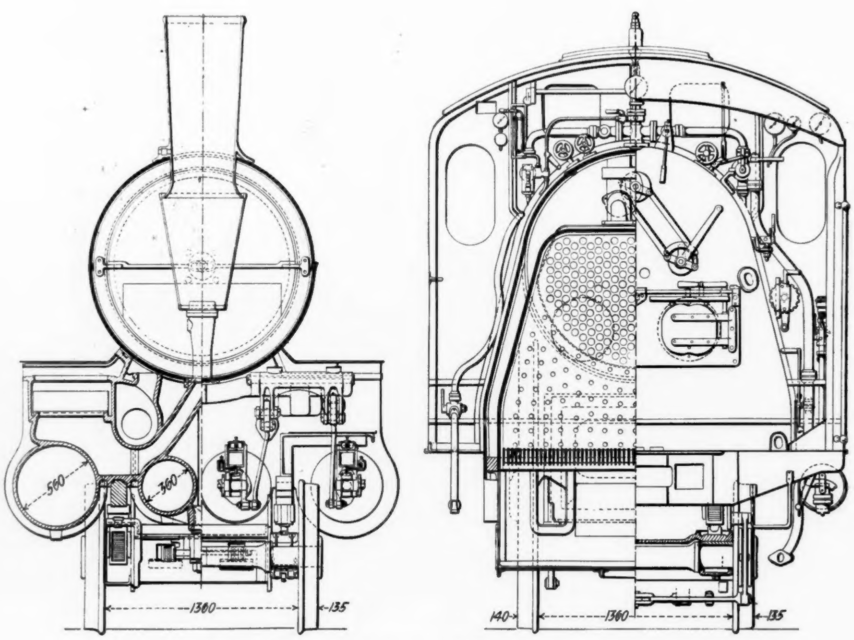
in which (d_1) is the diameter of the high-pressure cylinder in inches, (d_2) is the diameter of the low-pressure cylinder in inches, (l) is the stroke in inches, (p) is the boiler pressure in lbs. per sq. in., and (D) is the diameter of the drivers in inches.



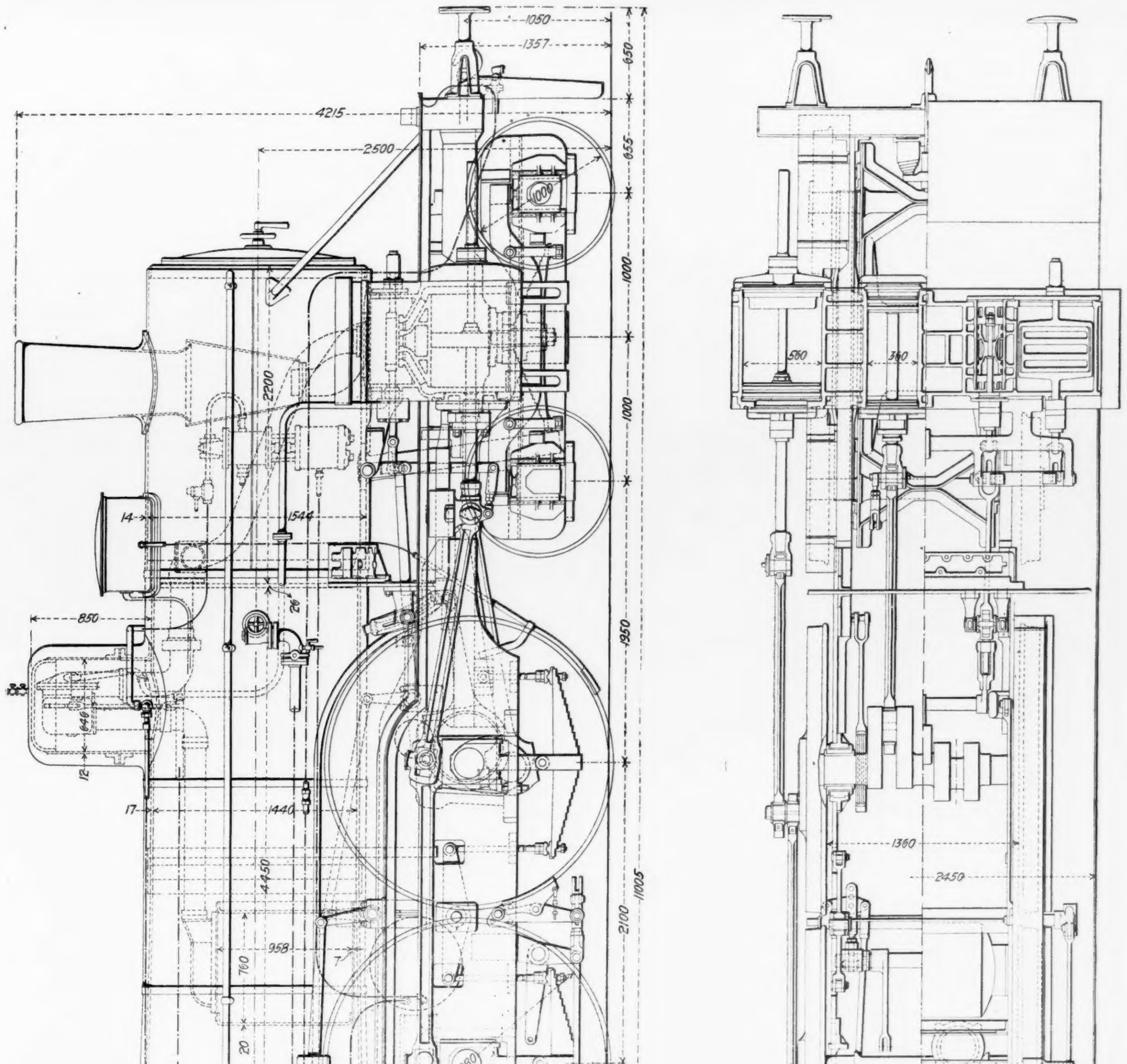
Four-Cylinder Balanced Compound Locomotive—Prussian State Railways.

The Pielock superheater with which the engine is fitted is built into the shell of the boiler so as to use the heating surface of the boiler tubes for superheating the steam. It is far enough from the fire-box so that the tubes cannot be overheated. The main part of the superheater consists of a box, into the ends of which the boiler tubes are lightly rolled. This box is divided into compartments by plates parallel to the tubes, so as to get a long contact of the steam with the heating surface. The steam passes at boiler pressure into the superheater and through the several compartments. A tube fitted with a draincock for ascertaining if the superheater is water tight, passes through

Pielock Superheater.



Prussian Four-Cylinder Balanced Compound.



Four-Cylinder Balanced Compound Locomotive for the Prussian State Railways.

the bottom of the superheater and boiler. A thermometer on the dome is connected by a pipe with the steam chamber of the superheater. The scale of the thermometer is placed so that it can be read from the cab.

Before being shipped to St. Louis, the locomotive was run on the Hanover Division for several days. The engine hauled trains weighing 300 tons at a maintained speed of 62 miles per hour on level track. On grades of 1 in 200 the speed was 50 miles an hour.

The Value of Heating Surface.

BY LAWFORD H. FRY.

By a paper* recently read before the Western Railroad Club, Mr. H. H. Vaughan has quickened general interest in the question of the relative value of the various parts of the heating surface in a locomotive. There is a good deal of talk about the advisability of making a series of tests to throw additional light on this important subject. If tests are to be made, it appears desirable to make an advance investigation of the ground to be covered, starting from first principles and endeavoring to determine the line of least resistance along which tests can be made. In the present article a preliminary survey is attempted which is an elaboration of a discussion of Mr. Vaughan's paper before the Western Railroad Club. Further investigation shows the necessity for modifying to some extent the formula then developed. In the present case each step in the argument is presented for criticism and correction if necessary.

It has been suggested that for purposes of experiment a special boiler be built, so that the length of flues, the number of flues, and the grate area can be altered, and the actual evaporation measured under various conditions. Probably, also, the method of introducing the feed water is of importance and should be included in any investigation. A set of tests on these lines would be costly and tedious to carry out; and owing to the large number of variables, it would be difficult to obtain any conclusive results. If, however, on any existing boiler a measurement is made of the change of temperature between fire and smoke-box, the evaporation due to each part of the boiler can be deduced, and by carrying out such experiments on a number of boilers the influences of varying conditions could be seen. In carrying out such tests it would be necessary to observe the quality of the fuel, the amount of the products of combustion, and the fall of temperature at intervals, between the fire and the smoke-box. The temperature measurements could be màde as has been similarly done for stationary boilers by means of an electrical pyrometer.

An attempt is made below to show how such a series of tests could be used and the form which the results would probably take. As a basis for the examination, Professor Goss's test of the Purdue boiler is taken. Information as to the conditions of combustion, etc., is given in the appendix below.

In carrying out the investigation the leading idea has been to study the principles governing the production of the heat at the grate and its transference to the water in the boiler. The formulæ obtained are probably applicable to general conditions, but they are offered here as an illustration of the form of the results to be expected from a series of temperature tests, and are not recommended for immediate adoption without further investigation.

In the appendix it is shown that in the case under consideration the heat production and distribution are as given in the following table. The figures given show the heat produced in an hour by each square foot of grate surface. The conditions are such as may be ordinarily obtained in locomotive practice.

Classification of Heat.	Amount of Heat per Sq. Ft. of Grate per Hour in B. T. U.	Percentage of Total Heat Produced.	
Heat radiated from grate—			
Effective in evaporation..	219,000	18.6	
Lost by outside radiation.	4,000	0.3	
Total heat radiated....	223,000		18.9
Heat carried from grate by gases—			
Effective in evaporation..	546,000	46.4	
Lost by outside radiation..	11,000	0.8	
Lost in smoke-box.......	399,000	33.9	
Total gas-carried, heat.	956,000		81.1
Total heat produced at grate per square foot of grate per hour	1,179,000		100.0
Heat lost by ashes and cinders	333,000		
Total heat of coal.....	1,512,000		

In this table and in the following investigation the transfer of the heat from grate to water is considered under two heads: (a) The heat radiated direct from the fire. (b) The heat carried from the fire to the heating surface by the products of combustion.

As pointed out by D. K. Clark in *The Steam Engine*, the heat leaves the fire surface in two forms. In the first place the glowing coal radiates heat direct through the ether to the fire-box walls, without affecting the atmosphere through which it passes. In the second place the gaseous products of combustion being heated to the temperature of the fire, carry off the remainder of the heat, of which they give up a certain portion as they come in contact with the surface of the fire-box and tubes. Pambour, in his treatise on "The Locomotive Engine," published in 1836, noticed these two forms of heat and pointed out the distinction to be observed between what he calls "radiative caloric" and "communicative caloric."

The amount of heat radiated by the fire is dependent only on the temperature of the fire and the surrounding fire-box. Peclet investigated the question of radiation, and his formula with a curve to facilitate its use is given in the appendix. It will be seen that in the case here considered the fire temperature is 1732 degrees F., giving a radiation of 223,000 B. T. U. per hour from each square foot of grate, or 18.9 per cent. of the heat produced at the grate. This radiated heat must be entirely absorbed by the fire-box surface, irrespective of the area. The fire-box heating surface and the tube ends immediately adjacent to the fire-box are the only parts exposed to the action of the radiated heat, and there is no opportunity for any radiation to escape.

Of the heat carried from the fire by the gases, a part is given up by the gases as they pass over the surface of the fire-box and the tubes, the remainder being carried with the gases into the smoke-box and lost. The amount of heat absorbed by the heating surface during the passage of the gases depends on the extent of the surface over which the gases pass, their rate of flow, and the rate at which the heat is transferred from the gases through the metal to the water. The laws governing this heat transference can be well studied by measuring the gas temperature at a number of points in the length of a flue. Such a series of tests not being immediately available, an attempt has been made to develop from first principles a formula to represent the relation between the heat extracted from the gases and the surface over which they pass. The methods adopted and the result obtained are set forth in the appendix. The formula (4) shows that with constant conditions of combustion, the heat absorbed is dependent only on the extent and not at all on the arrangement of the heating surface. That is to say, long and short tubes will absorb the same amount of heat, the amount of heating surface and the volume of gas being the same in both cases. This result was unexpected at first, but it appears to have a reasonable explanation. When two boilers have equal heating surfaces and tubes of different lengths, the shorter tubes must exceed the longer in number, and consequently offer a greater area for the passage of the gases. As the volume of gas passing per hour is the same for both boilers, it passes more slowly through the shorter tubes and the gases are in contact with the heating surface the same length of time in both cases. Though making an equal showing as to boiler economy, the shorter tubes show to advantage when the locomotive is considered as a whole. The two engines can be driven to the same power with less back pressure in the cylinders of that with the shorter tubes. The area of the tubes is greater, the length less, and the rate of gas travel slower, so that the resistance to the passage of the gases is less, and with the shorter flues a smaller smoke-box vacuum will maintain the same draft.

The formula (4) may be used for calculating the temperature at any point along the length of the flues. This was done for a number of points in the length of the Purdue boiler under the assumed conditions. The curve in Fig. 1 is plotted from these results and extended to show the temperature from the formula at the end of a 30-ft. flue.

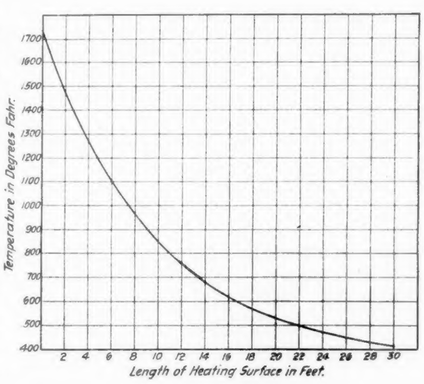


Fig. 1.—Temperature of Gases at Different Distances from Fire-Box.

A curve of this description obtained by actual measurements under service conditions would be of great value in studying the action of the boiler. It would enable one to calculate the smoke-box temperature and hence the heat-absorbing power of the boiler for any heating surface. The problem would be handled as follows: Given a grate of a certain area, producing a known quantity of heat in the hour. What amount of this heat will be absorbed by the heating surface? The temperature of the fire can be found from the known conditions of combustion, and hence the amount of radiated heat is easily found from the curve in Fig. 3. This heat is all absorbed by the boiler and can be counted on for evaporation. The remainder of the heat is carried off by the gases, and of this a certain proportion is absorbed. The proportion of heat absorbed depends, other things being equal, on the heating surface passed over by the gases. Now, if the grate remains of the same size, a change in the area of the heating surface means a

*See *Railroad Gazette*, April 22, 1904.

change in the ratio of grate area to heating surface. Consequently, an increase of the heating surface in proportion to the grate gives an increase in the proportion of the gas carried heat which is absorbed. Or, in other words, the proportion of gas-carried heat absorbed, is dependent on the ratio of grate area to heating surface. This relation is shown by the curve in Fig. 2, which is based on formula (5) of the appendix. The formula for the curve is not convenient for general use, but for all ratios of grate to heating surface between 40 and 100 the following approximate formula gives results very close to the actual curve.

$$p = 6.5 \sqrt{\frac{S}{G}}$$

where (p) is the percentage of heat absorbed from the gases, (S) is the heating surface, and (G) is the grate area; or

$$p = 6.5 \sqrt{C},$$

where (C) is the ratio of grate to heating surface.

In the case examined above the heat radiated from the grate amounts to 18.9 per

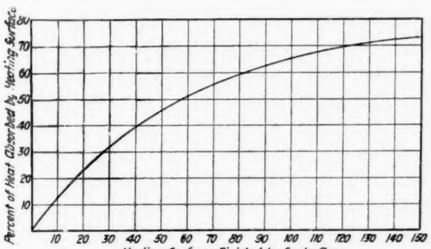


Fig. 2.—Curve of Heat Absorption.

cent., or, say, 19 per cent. of the total produced, leaving 81 per cent. to be carried off by the gases. Of this $6.5 \sqrt{C}$ per cent. is absorbed, or $52.6 \sqrt{C}$ per cent. of the total heat produced. Now to convert these figures into terms giving the evaporative power of the boiler. Under the assumed conditions each square foot of grate produces 1,179,000 B. T. U. per hour. The heat lost from the boiler by outside radiation would be a complicating factor in the following calculation, but for present purposes no great error will be made by deducting it directly from the heat produced at the grate, and taking no further account of it. This outside radiation loss was only taken into the former calculation for the sake of completeness, and not because it has any vital effect on the final results. Then deducting the outside radiation from the total heat produced, the remaining net heat available per hour for each square foot of grate is 1,164,000 B. T. U. If the feed water is supplied at a temperature of 65 degrees F., this heat is sufficient to produce 1,000 pounds of steam at 180 pounds boiler pressure. As the radiated heat is 19 per cent. of the heat produced, it will generate 190 pounds of steam per hour for each square foot of grate. The heat absorbed from the gases will generate $52.6 \sqrt{C}$ pounds of steam per hour for each square foot of grate. Consequently, the evaporative power of the boiler is given by the formula:

$$V = 190\,G + 52.6\,G \sqrt{C},$$

or,

$$V = 190\,G + 52.6 \sqrt{S.G} \quad (1)$$

where

V = pounds of steam at 180 lbs. boiler pressure produced per hour from feed water at 65 degrees F.

G = grate area in square feet.

S = total heating surface in square feet.

C = heating surface divided by grate area.

Under the conditions of the Purdue test this formula gives a correct value for the hourly evaporation, but it appears to give results which are rather too low for general conditions. The evaporation is only 5.65 pounds of water per pound of coal, while 6.5 or 7 would represent more nearly the best practice. If fuel of better quality is taken, the constants in the formula are increased and the relative amounts of gas-carried and radiant heat are considerably altered. For example, instead of coal of 13,000 B. T. U., take coal of 15,000 B. T. U., burning at 120 pounds per square foot of grate per hour, losing 18 per cent. of the heat in cinders, ashes, and outside radiation, and producing 19 pounds of gas per pound of coal. The heat at the grate will be 1,476,000 B. T. U. per square foot, or sufficient to produce 1,268 pounds of steam per hour. The fire temperature will be about 1,894 degrees, and of the heat produced about 29.8 per cent. will be radiated and about 70.2 per cent. carried off by the gases. The evaporation formula will be

$$V = 378\,G + 57.8 \sqrt{S.G} \quad (2).$$

It will be noticed that in substituting excellent coal for that of medium quality the increase in evaporation is gained chiefly in that portion due to the radiant heat. The first term of the formula, which is that giving the evaporation due to the radiated heat, is practically doubled, while the second term, which gives the evaporation from the gas-carried heat, is only increased about 10 per cent. With a boiler of the proportions of the Purdue boiler the total evaporation is increased about 35.6 per cent. by using the better quality coal, while the actual heat at the grate is only increased 26.8 per cent.

The two formulæ (1) and (2) give evaporative results, respectively, too low and too high to represent general conditions, and a mean between the two will probably give results which more nearly represent average working conditions, as, say,

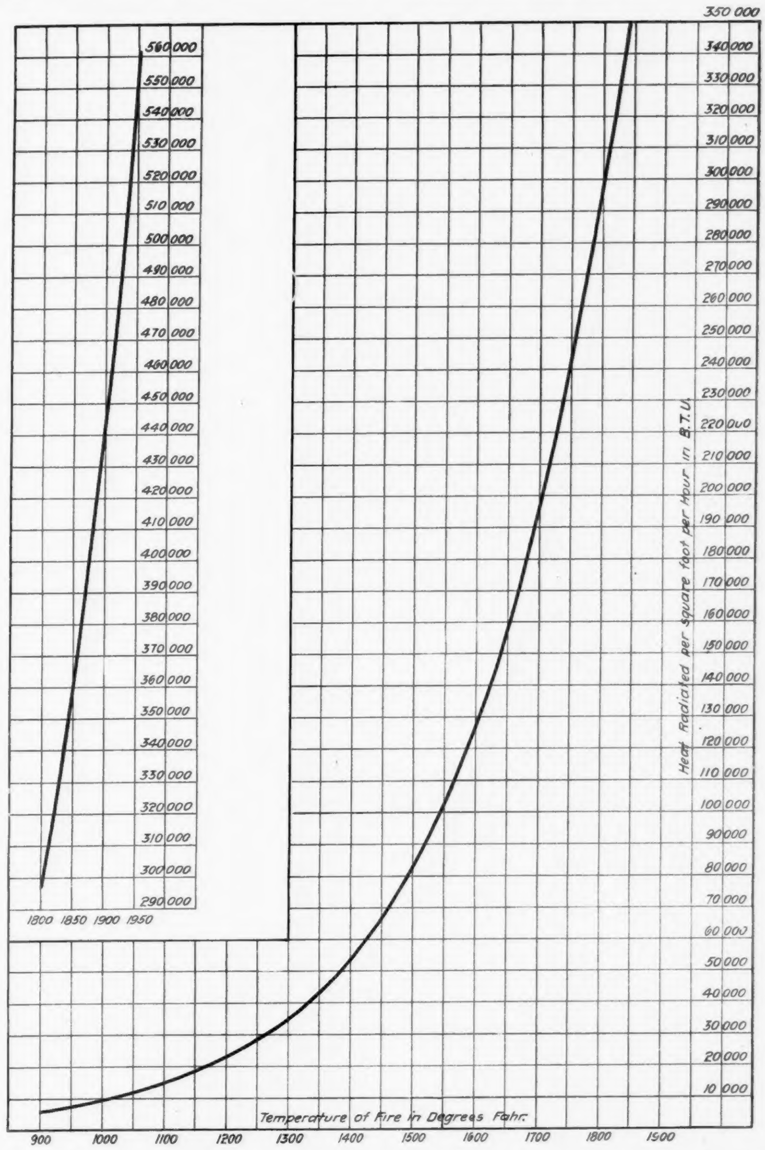


Fig. 3.—Diagram of Peclet's Formula for Quantity of Heat Radiated From Fire.

$$V = 280\,G + 55 \sqrt{S.G} \quad (3).$$

Now to consider the foregoing in relation to tests to be made. The action of the radiant heat as covered by the first term of the evaporation formula is based on Peclet's work, which appears to be reliable. The second term of the formula is based on the curves in Figs. 2 and 3. These curves should be confirmed or replaced by curves plotted from temperature measurements on boilers in service. It is probable that while the general shape of the curves will be sustained, there will be some change in the proportions. The curves are calculated on the assumption that the rate of transfer of heat from gas to water is proportional to the difference in temperature between gas and water. Now it is certain that through the metal of the tube the

rate of transmission of heat is proportional to the difference in temperature between the two sides of the metal, but in the transfer of heat from the gases to the tube, and from the metal to the water, the relation between the rate of transfer and the temperature is not so well determined. It is probable that the rate of transfer of heat from tube to water is dependent on the rate of circulation of the water about the tube, as well as on the temperature, and that, consequently, the more rapid ebullition of the water about the fire-box and the fire-box end of the tubes, accelerates the transfer of heat and makes the part of the heating surface nearest the fire more efficient in reality than it is shown to be by the curves. If this is true a curve of fall of temperature plotted from experiments would drop more rapidly at the beginning than is the case with the curve in Fig. 1, and as a consequence, the actual curve of heat absorption would rise at the start more rapidly than the curve in Fig. 2.

The effect of various methods of feed water introduction could also be studied by comparing the curves showing the fall of temperature along the tubes. Any gain in evaporation would be accompanied by a corresponding lowering of the smoke-box temperature, and the differences in the shape of the curves would show just where the improvement was effected.

Formulæ (4) and (5), which are intended to give the evaporative power of a locomotive boiler, can be and should be checked in two ways. The first way, and one which lies readily to hand, is to compare the evaporation calculated by the formula with that actually obtained. The second and more far-reaching check is to carry out temperature measurements giving curves similar to those in Figs. 1 and 2, but plotted from actual observations. Then the principles on which the formulæ are grounded can be examined, and, if necessary, modified, and eventually a formula for the steam-producing power of a boiler can be built up by a logical process from observed facts.

APPENDIX.

Combustion Conditions.—The conditions of combustion chosen for the analysis of heat production and transference are those of test 23, reported by Prof. W. F. M. Goss, in his paper on "Tests of the Boiler of the Purdue Locomotive," presented at the New York meeting (December, 1900) of the American Society of Mechanical Engineers. (Trans., Vol. XXII., p. 453). To fully analyze the action of the fire it is necessary, in addition to the data given, to know the heat lost by ashes and cinders. This is therefore assumed to be 22 per cent. of the total heating value of the coal. Professor Goss gives the heating value as approximately 13,000 B. T. U. per pound of dry coal, and this figure is used for present purposes. The outside radiation from the boiler is assumed to be 1 per cent. of the total heating value of the coal.

On each square foot of grate 116.3 pounds of coal are burned per hour, producing 1,512,000 B. T. U. per hour. The total heat effective in evaporation, as reported in Professor Goss's paper (col. 35, p. 468), is 220,000 B. T. U. per minute, that is, 765,000 B. T. U. per square foot of grate per hour. Consequently, the difference (747,000 B. T. U. per square foot of grate per hour) is lost, and this lost heat is divided as follows:

		Per Hour.
Total heat lost per sq. ft. per hour......		747,000
Heat lost in ashes and cinders (22 per cent. of total)..........	333,000	
Heat lost by outside radiation (1 per cent. of total)...........	15,000	
		348,000
Remainder		399,000

This remainder is the amount of heat carried to the smoke-box by the products of combustion from each square foot of grate. As the smoke-box temperature is 724 deg. F., and the specific heat of the products of combustion is 0.24, the weight of gases passing through the smoke-box per hour must be 2,300 pounds per square foot of grate, or 19.75 pounds for each pound of coal burned. From this information and Peclet's formula the temperature of the fire can be calculated as explained below.

The following results are obtained:

	B. T. U. Per Hour.
Total heat of coal per sq. ft. of grate..	1,512,000
Losses by ashes and cinders...........	333,000
Heat produced at grate.............	1,179,000

The fire temperature is found to be 1,732 degrees F., the heat being carried away as follows:

	B. T. U
Heat radiated from each sq. ft. of grate.	223,000
Heat carried by gases from each sq. ft. of grate	956,000
Total heat from each sq. ft. of grate..	1,170,000

Of the 956,000 B. T. U. of heat carried by the gases, 399,000 B. T. U. are lost in the smoke-box, leaving 557,000 B. T. U. to be absorbed by the heating surface. The total heat absorbed by the boiler is therefore 780,000 B. T. U., and 15,000 B. T. U. being lost by outside radiation, leaves 765,000 B. T. U. effective for evaporation. If the outside evaporation loss is divided proportionately between the radiated and the gas-carried heat, the amount of effective heat absorbed from the gases is 546,000 B. T. U., while the effective heat radiated from the fire is 219,000 B. T. U. These results are summarized in the table in the body of the article.

Radiated Heat.—Peclet's formula as given by D. K. Clark in the *Steam Engine*, gives a means of calculating the amount of heat radiated per hour from each square foot of a coal or coke fire, the temperature of the fire being known. The formula is:

$$R = 144\, a^t\, (a^d - 1)$$

where R is heat radiated per hour in B. T. U., t is temperature of enclosure in degrees F., d is difference between temperatures of fire and enclosure in degrees F., and $a = 1.00425$. Then if the boiler pressure is 180 lbs. per sq. in. and (T) is the fire temperature $t = 380$ deg. F. and $d = T - 380$. On this basis the curve in Fig. 1 has been constructed showing the rate of radiation for all fire temperatures between 900 deg. and 1,900 deg. F. It will be seen that with increasing temperature the rate of radiation increases very rapidly. In giving the above formula Clark explains fully the method of applying it to the calculation of fire temperatures. The weight of gases passing each square foot of grate being known, the amount of heat carried by the gases at any temperature of the fire is known. Then by trial a temperature is found at which the heat carried by the gases, together with the heat radiated, just amounts to the total heat produced at the grate.

Temperature Lost by Gases in Passing Over Heating Surface.—Assume that the rate of transfer of heat from the gases in the boiler tubes to the water in the interior of the boiler, is proportional to the difference of temperature between the two points. This is in accordance with Rankine's work, and gives a point from which to start.

Let S = the heating surface in square feet;
h = the time in hours;
w = the weight of gas in pounds per square of grate per hour;
G = the grate area in square feet;
r = the specific heat of the gases;
m = the number of B.T.U. transmitted through each square foot of heating surface for each degree of temperature difference;
T = the temperature of the gases in deg. F.;
T_b = the temperature of the water and steam in deg. F.;
$t = T - T_b$ the difference of temperature in deg. F.

Then the heat transferred through the element of heating surface $\triangle S$ in the element of time $\triangle h$ is $(m)\,(t)\,(\triangle S)\,(\triangle h)$. The gas passing in this time is $(w)\,(G)\,(\triangle h)$, and in consequence of the above heat transference the temperature loss is $-\triangle t$; then the heat lost by the gas is $-(\triangle t)\,(r)\,(w)\,(G)\,(\triangle h)$, and equating the heat transferred and the heat lost by the gas:

$$(m)\,(t)\,(\triangle S)\,(\triangle h) = -(\triangle t)\,(r)\,(w)\,(G)\,(\triangle h)$$

therefore, $\left(\dfrac{r\,wG}{m}\right)\left(\dfrac{\triangle t}{t}\right) = -\triangle S$

Now if a steady rate of combustion is maintained $\dfrac{r\,wG}{m}$ remains constant and may be replaced by the symbol (k). Then

$$k\,\frac{\triangle t}{t} = -\triangle S$$

and reducing the differences to their limiting values

$$k\,\frac{dt}{t} = -dS;$$

hence $k\displaystyle\int\frac{dt}{t} = -\int dS$

or, integrating to limits as shown,

$$k\left[\log_e t\right]_t^{t_o} = -\left[S\right]_S^o$$

hence $k\,(\log_e t_o - \log_e t) = S$

Here (t_o) is the initial temperature of the gases on leaving the fire and the logarithms are to the base (e). By substituting $K = \dfrac{k}{2.303}$ for (k) the logarithms are transformed to the usual base 10 and the expression becomes:

$$K \log\left(\frac{t_o}{t}\right) = S \;\ldots.(4)$$

The Purdue test analyzed above affords an opportunity for determining the value of the constant K in a particular case. The heating surface is 1,347 sq. ft., the steam pressure is 122.5 lbs. per sq. in. corresponding to a boiler temperature of say 352 deg. The fire temperature is 1,732 deg. and the smoke-box temperature is 724 deg. Hence $K \log \dfrac{1380}{372} = 1347$ and $K = 2360$. On this basis the curve in Fig. 2 is plotted.

The flues are 11.5 ft. long and have 1,204 sq. ft. of heating surface, so that if the fire-box heating surface be treated as though it were an extension of the flues the total heating surface of 1,347 sq. ft. will have a representative length of 12.8 ft. The curve in Fig. 1 shows how the temperature falls from an initial temperature of 1,732 deg. to a temperature of 724 deg. after passing over 12.8 lin. ft., or 1,347 sq. ft. of heating surface. If the tubes were extended, other conditions remaining the same, the temperature would fall as shown, up to a flue length of 30 ft.

In equation (4) the constant includes the area of the grate since $K = \dfrac{P\,wG}{2.303m}$. This is eliminated by writing $K_1 = \dfrac{P\,w}{2.303m}$, so that equation 4 becomes:

$$K_1 \log\left(\frac{t_o}{t}\right) = \frac{S}{G} \;\ldots.(5)$$

This gives the smoke-box temperature (t) in terms of the initial temperature (t_o) and the ratio of grate to heating surface $\left(\dfrac{S}{G}\right)$. This equation, with K_1 having the value obtained from the Purdue test, is plotted in the curve in Fig. 3.

Railroad Shop Tools.

AXLE LATHES (*Continued*).

The double end axle lathe shown in Fig. 1 is made by the Lodge & Shipley Machine Tool Company, Cincinnati, Ohio. This machine embodies several novel features. The bed is of an entirely new and massive design. It is provided with separate ways for the carriages and tailstocks, the ways for the latter being in the form of a dovetail inclined at an angle. The base of the tail-stock engages directly into the dovetail and the upthrust of the cutting tool is taken directly by the casting instead of on clamping bolts. Throughout the entire length of the bed are four vertical beams, or webs, so placed that the strains on the tail-stock act up through the two rear webs, while the two front webs come directly under the carriage and receive the entire downward pressure of the cutting tool.

The driving mechanism consists of a three-step cone running between self-oiling bearings and having diameters of 20 in., 25 in. and 30 in. by 6½-in. face. The inner end of the cone shaft is connected through two changes of gearing directly to a short driving shaft at the back of the lathe. This driving shaft is geared into a central driving gear 30 in. in diameter by 4 in. face, mounted between bearings at the center of the bed. An equalizing driving plate having a 15 in. opening in its center transfers the power to the axle. The ratios of gearing between the cone-pulley-shaft and central driving gear are 6.1:1 and 20.9:1, which, with the three changes on the cone-pulley, gives six cutting speeds. A hand-wheel and shaft near the cone-pulley provide means of changing from one gear to the other.

The carriages are arranged to take one or more tools. The feed instead of being obtained by a rack and pinion is got by a bronze nut 14 in. long, which encircles the stationary lead screw. This screw is cut with a double thread having a 1 in. lead. With this arrangement, it is claimed that a more powerful feed is obtained, and also greater wearing qualities. The nut is revolved for the regular feed by a feed rod driven by gears from the cone pulley shaft.

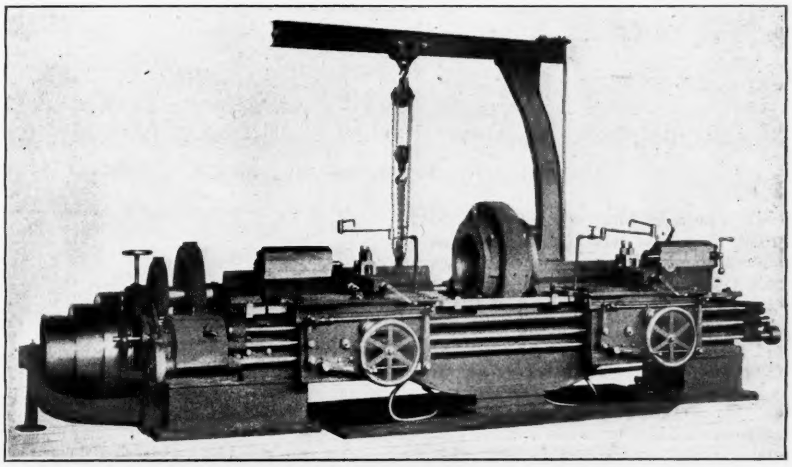


Fig. 1—The Lodge and Shipley Double Axle Lathe.

Another feed rod directly under this, driven by an independent belt, runs constantly at a high speed and affords a means of moving the carriage rapidly in either direction. At the front of the apron are three levers. The one at the left starts or stops the feed; the lever at the bottom is for reversing, and that at the right applies the quick movement to the carriage. A safety device in the apron prevents the feed for turning and the feed for the quick movement being engaged at the same time. The hand wheel movement can always be used. Automatic stops in both directions for each carriage are provided and calipering stops can be applied to each tool for duplicating diameters. Shear wipers keep the ways free from dirt and grit.

The tail-stocks are shaped to allow the carriage to pass when starting a cut at the end of the axle. A rack and pinion movement facilitates the movement of both tail-stocks to accommodate different lengths of axles. A pawl in the rear of each tail-stock engaging in this rack forms a positive lock against end movement. The tail-stock spindle instead of being round is a dovetail with a gib at the bottom for taking up the wear.

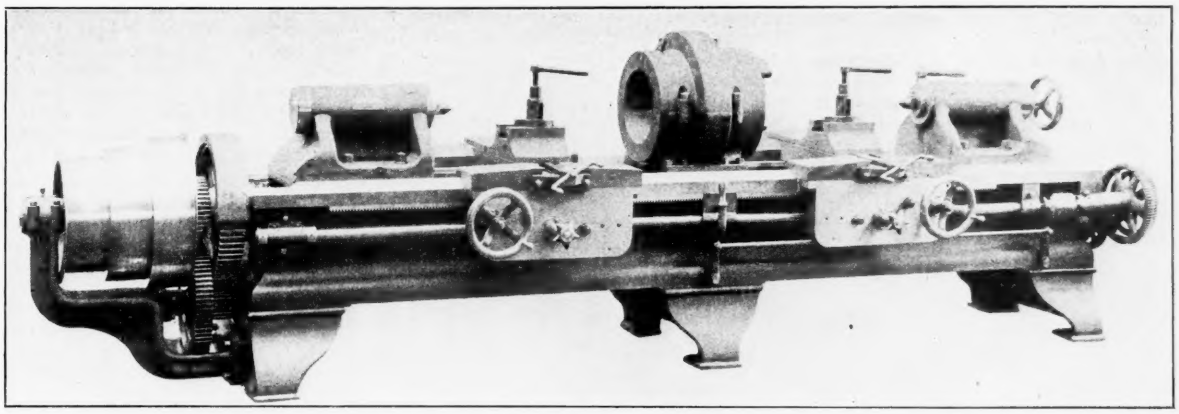


Fig. 2—The Bridgeford Double Axle Lathe.

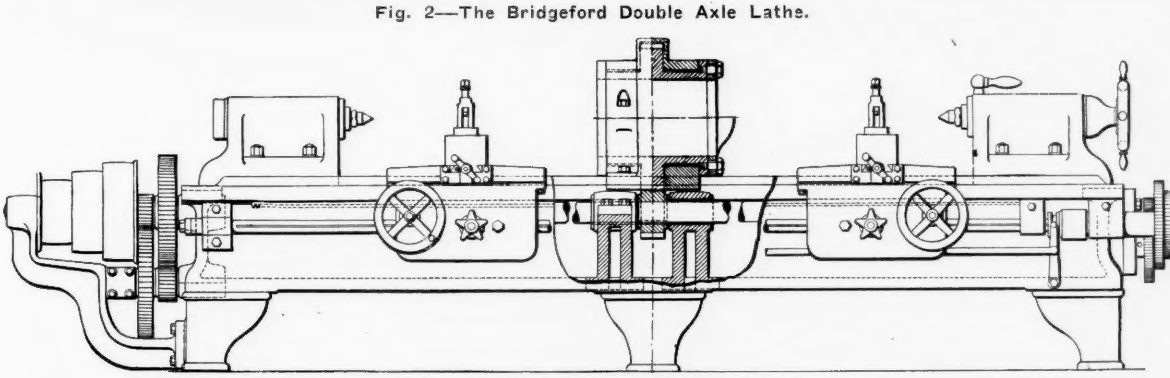


Fig. 3—The Bridgeford Double Axle Lathe.

The feeds obtainable on this lathe are six in number—3-5-8-11-16 and 32 to an inch—any of which can be obtained while the machine is running, by a movement of a lever shown at the head of the lathe. The complete weight of this axle lathe with counter-shaft, oil pump and pan is 19,000 lbs.

The double end axle lathe shown in Figs.

2 and 3 is built by Charles Bridgeford, Rochester, N. Y., and is designed to meet modern tool steel requirements. The main driving spindle is crucible steel 3 15/16 in. in diameter, and runs the entire length of the lathe in six brass boxes. The spindle is connected to the driving head by a heavy steel pinion 8½ in. in diameter with a 4 in. face, which runs between two heavy brass bearings 9 in. long. The driving head is fitted with two brass liners each 6 in. wide and 15½ in. in diameter, in which the steel driving gear revolves. The driving head has an opening of 13 in. for the axle to pass through, and has a double self-centering steel driver. The axle revolving on dead centers is turned and finished complete at each end without reversing. The cone has three steps for a 6 in. belt, the largest step being 24 in. in diameter and the smallest being 18 in. The cone is fitted with brass bushings. There are two independent carriages, each having a bearing on the ways of 30 in. The carriages are driven by a spline in the feed shaft with rack and pinion.

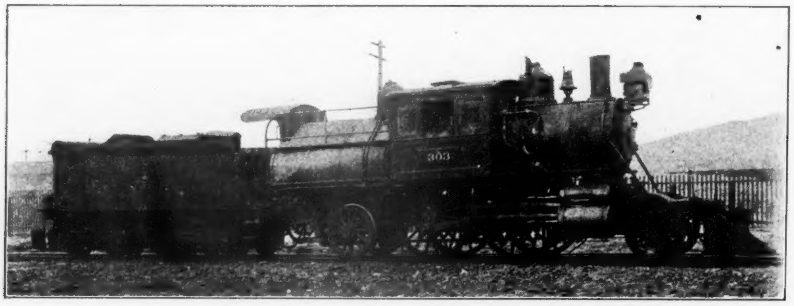
There are four changes of feed, which are connected to the main driving spindle by gearing, and are so arranged that two different feeds can be had for each change of gear on the feed shaft. The feeds are arranged so that the roughing cuts can be instantly changed to finishing cuts, or vice versa, by shifting the lever at the front of the machine. The tail-stocks are 24 in. long and 19 in. wide, and are secured to the bed with four bolts and heavy binders. The left-hand tail-stock is split and is adjustable. The spindle in the right-hand tail-stock is adjusted by a steel screw and hand wheel, and in both tailstocks the spindle can be clamped with split binders. The centers are tool steel 2 in. in diameter. The feed shaft is steel 1 15/16 in. in diameter. All pinions, large and small, are steel. Pulleys on the countershaft are 18 in. in diameter by 7¼ in. face, fitted with brass bushings. The bushings and the hangers are self-oiling. The maximum distance between centers is 7 ft. 8 in.; the swing over the ways is 27 in., and the swing over the carriage is 14 in. The bed is 28½ in. wide and 18 in. deep, reinforced with heavy box cross-ties. The weight of this lathe is 15,000 lbs. net.

(To be continued.)

The travel on the city elevated railroads in Vienna, which have been opened only a few years, decreased about 5½ per cent. in 1903, and the working expenses were 110 per cent. of the earnings in 1903, against 109 per cent. the year before. When the road was built it seemed very much needed; but the street horse railroads have been changed to electric lines since. The elevated is still worked by steam, but there is talk of changing to electricity.

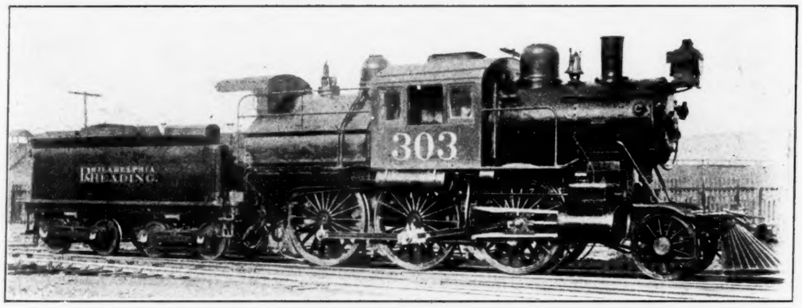
Rebuilding Locomotives—Philadelphia & Reading.

BY S. F. PRINCE, JR.



Locomotive No. 303 Before Rebuilding.

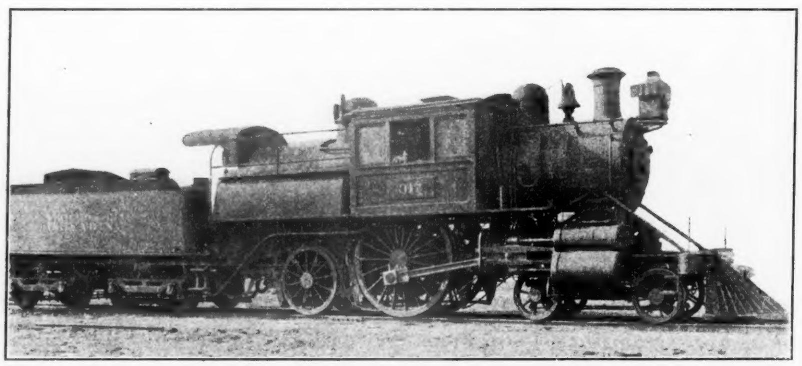
The examples of rebuilding shown herewith are the outcome in one case of frequent breaking of frames and cylinders and in the other of an effort to increase the adhesion of an engine in order to handle trains when running in average or in pooled service. The first case is that of a Columbia or 2-4-2 type of engine which was frequently shopped on account of broken frames and cylinders. In rebuilding it was desirable, if possible, to make it a more efficient engine. With that in view it was decided to replace the trailing wheels with driving wheels, thus making it of the mogul type (2-6-0) and suitable for heavy passenger service. The photographs of engine 303 will clearly show the design before and after rebuilding. The pony or engine truck is not equalized with the drivers, the weight going to the truck being directly transmitted to it through a solid cast-iron bed plate or frame filling-casting which is bolted between the front frames and has a center plate cast thereon. The only change made in the boiler was to remove the combustion chamber and to substitute shaking for water-bar grates.



Locomotive No. 303 After Rebuilding.

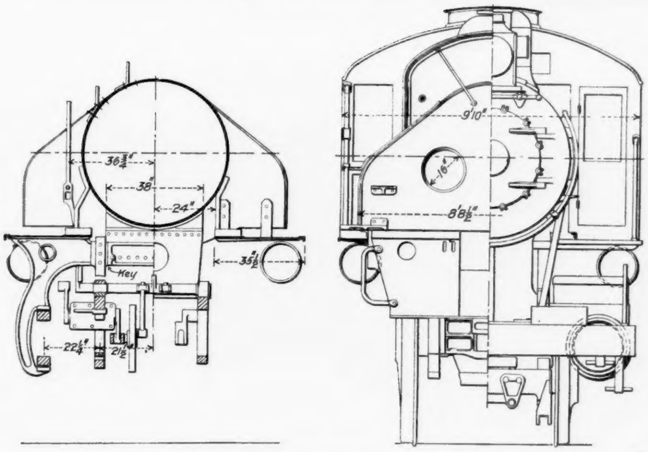
Placing 78 in. driving wheels under the wide fire-box necessitated raising the boiler up for clearance, and this required that the pops and whistle be removed from the dome on account of overhead clearance and placed on a turret on the back of the boiler. The ash-pan is provided with side pans equipped with adjustable side registers for draft regulation. The frames, guide yoke and tail piece are cast steel, the latter being held in place by bolts and vertical wedges.

In the case of engine 317, originally having a single pair of drivers (4-2-2 type), it was found to be practically impossible to find a service for which this type of engine was adapted. It might have a suitable train one way over the road but on the return trip the load or number of stops would almost invariably render schedule time an impossibility. Also when shortage of power

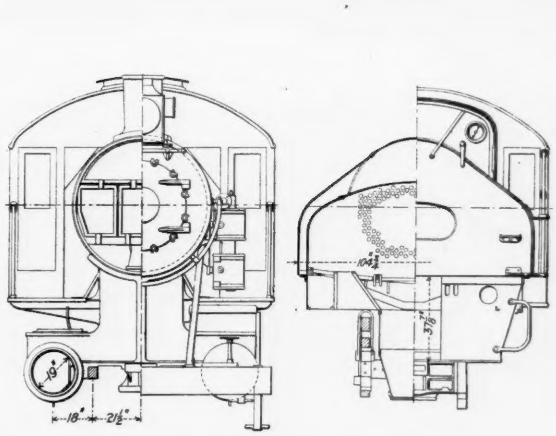


Locomotive No. 317 Before Rebuilding.

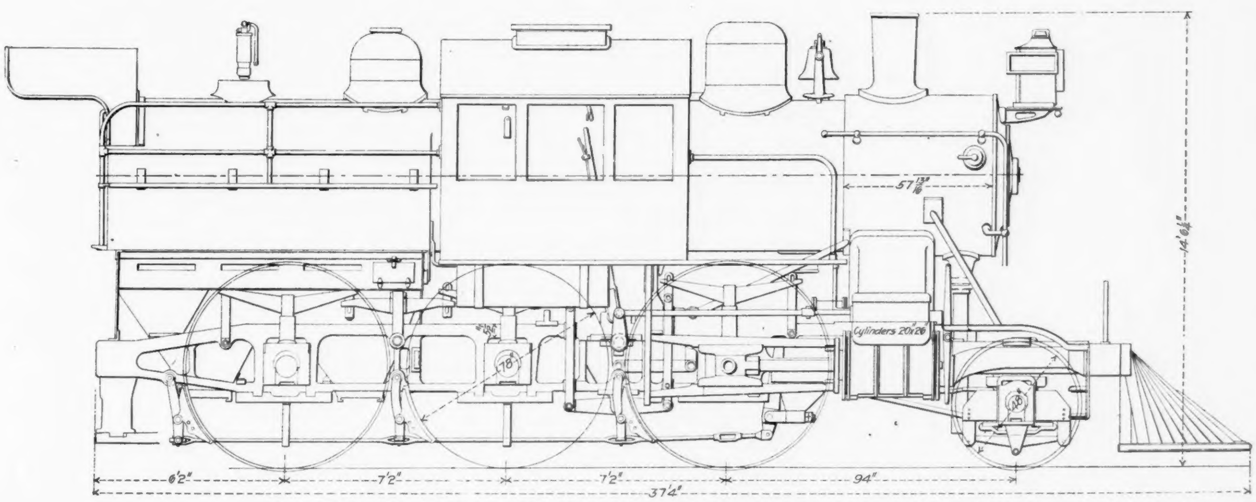
Locomotive No. 317 After Rebuilding.



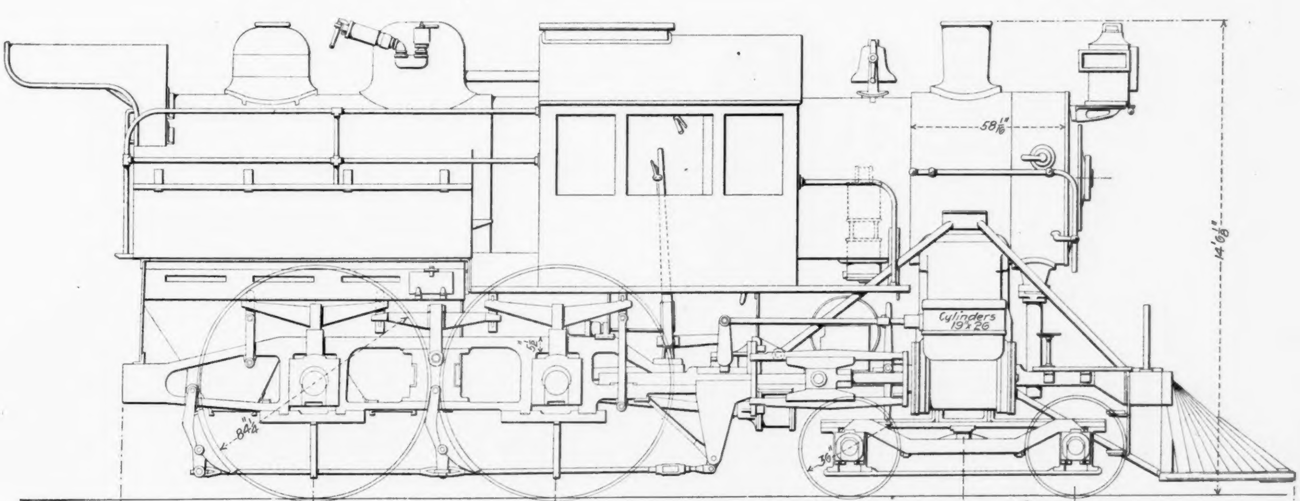
Rebuilt Locomotive No. 303.



Rebuilt Locomotive No. 317.



Locomotive No. 303 After Rebuilding—Philadelphia & Reading.



Locomotive No. 317 After Rebuilding—Philadelphia & Reading.

exists (a chronic condition in American railroad service) and the engine pool is resorted to, an engine of this type is utterly unfitted for the service. The pioneer engine of this type built in 1880 with a traction increaser failed to overcome the above objections, and the tendency to slip required frequent shopping of engine for tire turning. In the rebuilding, another pair of driving wheels of the same size (84¼ in.) were placed under the engine, and changes in the boiler similar to those made on the Columbia type were made. Seventeen, engines with 78 in. driving wheels and two engines with 84¼ in. wheels are now in service. The accompanying table gives the principal dimensions of both classes of engines before and after rebuilding.

Rebuilding Locomotives.

Engine number	317.		303.	
	Original.	Rebuilt.	Original.	Rebuilt.
Type	4-2-2	4-4-0	2-4-2	2-6-0
Simple or compound	Compound	Simple	Compound	Simple
Cylinder diameter, h. p., in	13	19	13	20
Cylinder diameter, l. p., in	22	..	22	..
Piston stroke, in	26	26	24	26
Type of valve	Piston	Rich. Bal.	Piston	Rich. Bal.
Diameter of valve, in	11½	..	10½	..
Lap of valve, h. p., in	⅞	1¼	⅞	1¼
Lap of valve, l. p., in	⅝	..	⅝	..
Exhaust clearance, in	⅛	⅛	0	⅛
Travel of valve, in	5⅝	7	5	7 1-32
Lead of valve, in	1-10	1-10	1-10	1-10
Steam port length, in	27	19	27	19
Steam port, width, in	1½	1⅝	1½	1⅝
Exhaust port length., in	27	19	27	19
Exhaust port width, in	4½	3	4½	3
Diam. of boiler (front), in	58¾	58¾	57½	57½
Number of flues	373	279	324	285
Diam. of flues, in	1½	1¾	1½	1½
Length of flues (over sheets), ft. and in	10 3	13 7⅜	10 0	13 4⅜
Combustion chamber	With	Without	With	Without
Grate, length, ft. and in	9 6	9 6	9 6	9 6
Grate, width, ft.	8	8	8	8
Grate, area, sq. ft	76	76	76	76
Height from rail to center of boiler, ft	8 9¼	9 9	8 4	9 4
Heating surface, flues, sq. ft	1,489	1,730	1,261	1,628
Heating surface, furnace, sq. ft	175	137	168	137
Heating surface, total, sq. ft	1,664	1,867	1,429	1,765
Steam pressure, lbs	200	200	175	175
Wheel base (driving), ft. and in	..	7 6	13 10	14 4
Wheel base (total), ft. and in	22 9	23 6½	23 4	23 8
Wheel diameter (drivers), in	84¼	84¼	78	78
Wheel diameter (truck), in	36	36	48	48
Wheel diameter (trailers), in	54	..	48	..
Weight on drivers, lbs	53,200	100,800	73,300	131,400
Weight on truck, lbs	43,900	46,700	32,400	27,900
Weight on trailers, lbs	29,500	......	34,300	......
Weight, total, lbs	126,600	147,500	140,000	159,300

Heating Surface and Boiler Power.

BY L. B. JONES.

The question has already been asked whether large heating surface pays, or whether it is necessary. The present fad, if such we may call it, for excessive heating surface had its origin at the same time grate areas were increased, and at that time it seemed to be the logical course. The result was a better steaming engine, but was the improvement due to the increase in heating surface, or to the larger grate? In connection with this question the accompanying speed diagram of a performance by one of the Pennsylvania E_2 engines is interesting. As is well known to the readers of the *Railroad Gazette*, the fastest train service in the world is maintained between Camden, N. J., and Atlantic City by the Pennsylvania and the Philadelphia & Reading railroads. The schedule of both roads calls for a 60-minute trip from the Philadelphia wharf to Atlantic City, including the ferry across the Delaware River and the transfer of passengers. By the Pennsylvania route the ferry and transfer requires at least six minutes, so that the 58.3 miles from Camden to Atlantic City must be regularly run in 54 minutes and often in a considerably shorter time. By the Reading route the ferry is longer and the railroad somewhat shorter, but the speed diagrams of the two runs and the profiles of the roads are very similar. The accompanying speed diagram was taken on Pennsylvania train 269 on Sept. 18, 1903, leaving Market St. wharf at 5:00 p. m. and due in Atlantic City at 6:00 p. m. The times given were taken by two observers and are substantially correct, the speed diagram having been plotted by noting the time at each mile post.

	Hrs.	Mins.	Sec.
Leave Camden	5	6	38
Pass Winslow Junction	5	33	36
Pass Drawbridge	5	56	25
Arrive Atlantic City	5	59	6

The distance from Winslow Junction to Drawbridge on this run was covered in 22 minutes 49 seconds, or 80.5 miles per hour for 30.6 miles.

The train consisted of a locomotive and seven cars, as follows:

	Weight, Lbs.
5 Penn. R. R. "Pk." coaches	295,000
1 Penn. R. R. "Cb" parlor car	68,800
1 Penn. R. R. "club car" (est.)	50,000
Locomotive 6065	176,600
Tender one-half loaded	104,000
350 Passengers (est.)	[illegible]
Total, engine and train	746,900

The 6065 was built in 1901 and is one of the earlier E_2 engines. All the engines of this class built since June, 1902, have been designated Class E_{2a} and have a Belpaire boiler and more weight on drivers than class E_2, which has a straight top boiler and radial stays. The principal dimensions of the 6065 are as follows:

Wheel arrangement	4-4-2
Total weight in working order, lbs	176,600
Weight on drivers, lbs	109,033
Cylinders, in	20½x26
Diameter of driving wheels, in	80
Type of boiler	Straight radial stay
Grate area, sq. ft	55.5
Length of tubes, ft	15
Heating surface, total, sq. ft	2,640
Heating surface, fire-box, sq. ft	166
Working steam pressure, lbs	205
Ratio of heating to grate surface	47.56

The practice in making up trains for this run is to place about a dozen cars on the stub track and unlock the coaches as the forward ones fill up, so that the train load is never heavier than necessary and the seats are always well filled.

This is very fast running, but this particular run is in no way unusual—the service is maintained all the year round by one train each day, and during the busy summer season three 60-minute trains are run by each road. The train load is often heavier than seven cars, and the schedule is easily made with 10 cars, or a total weight of train of 946,400 lbs. The profile shows that there are no grades steeper than 30 ft. per mile, and outside of the Camden City limits there are no curves as sharp as 2 degs. The line between Winslow Junction and Absecon is a tangent with a total fall in favor of the locomotive of about 3.5 feet per mile—too small to be considered at a speed of 80 miles per hour. Water was taken from the track tanks just before passing Winslow Junction, and from this point to Drawbridge the average speed was 80.5 miles per hour.

There are undoubtedly many special runs and runs to make up time on record which exceed this performance in point of speed, but the writer believes that there is only one other place in this country where a speed of 80 miles per hour is attained in regular daily running, and there only for a few miles.

The various formulæ for train resistance are widely at variance for high speeds, so that any attempt to compute the power developed is more or less unsatisfactory; but for purposes of comparison the method used by Mr. E. L. Coster in a letter to the *Engineer*, of London, of Nov. 13, 1903, furnished some interesting data. Mr. Coster describes a performance by Atlantic-type locomotive 483 on the Michigan Central, in which a train of 16 cars weighing 605.57 tons was hauled 118.22 miles in 127 minutes, or a speed of 55.8 miles per hour. The rolling resistance of the train was taken from the *Engineering News* formula, the wind resistance was computed from the formula by Prof. Goss, and 10 per cent. was added to the total cylinder tractive effort for engine friction; the results showing a drawbar horse-power of 1597.37, a total horse-power of 2123.38, and a total water consumption, at the rate of 27 lbs. per i.h.p. per hour, of 57,331 lbs. per hour. The locomotive has a large heating surface (3,505 sq. ft.), so that the evaporation per sq. ft. of heating surface per hour was only 16.28 lbs., but the grate area, 50.3 sq. ft., is practically the same as that of the 6065, which is 55.5 sq. ft.

Applying these calculations to train 269 of the Pennsylvania, we obtain the following results:

For the internal tractive resistance of the train, from the *Engineering News* formula:

$$R = 2 + \frac{V}{4} = 2 + \frac{80.5}{4} = 22.1,$$

where R is the resistance in lbs. per ton of 2,000 lbs. For the wind resistance of the train Prof. Goss' formula gives:

$$R_a = (.016 + .02C)V^2,$$

and for the engine and train

$$R'_a = (.13 + .02C)V^2,$$

where R_a is the total wind resistance in lbs., C is the number of cars in the train, and V is the speed in miles per hour. Substituting in the above, C = 7 and V = 80.5, we have

$$R_a = .156\,V^2 = 1011 \text{ lbs},$$

$$\text{and } R'_a = .27\,V^2 = 1750 \text{ lbs}.$$

The drawbar tractive effort for the train of 233 tons then becomes:

$$T_d = 233 \times 22.1 + 1011 = 6160 \text{ lbs}.$$

The total cylinder tractive effort for the entire train of 373.5 tons, adding 10 per cent. for engine friction, will be:

$$T = 373.5 \times 22.1 \times 1.1 + 1750 = 10{,}830 \text{ lbs}.$$

The horse-power developed is found from the formula:

$$\text{H.P.} = \frac{\text{Trac. effort} \times \text{speed in miles per hr.}}{375}$$

The drawbar h.p. then becomes:

$$\frac{6160 \times 80.5}{375} = 1322,$$

and the total indicated h.p.:

$$\frac{10{,}830 \times 80.5}{375} = 2325.$$

Mr. Coster assumes a steam consumption of 27 lbs. per i.h.p. per hour, and at this rate the Pennsylvania engine would require 2325 × 27, or very nearly 63,000 lbs. of water per hour. At this speed, however, it is reasonable to assume that the cylinders were using the steam economically, and if we assume a consumption of 24 lbs. per i.h.p. hour we have a total consumption of 55,800 lbs. per hour, or an evaporation of 21.1 lbs. per sq. ft. of heating surface per hour.

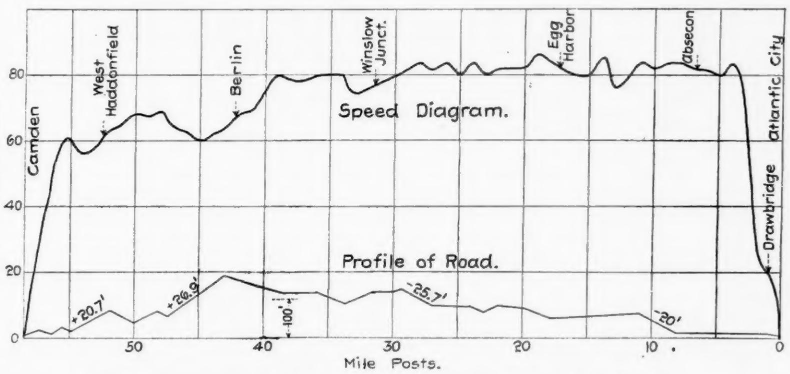
These figures are, perhaps, too high, but they afford an excellent basis for a comparison. We do not know whether the Michigan Central locomotive was forced to the limit of its boiler, but we know that the Pennsylvania engine was not forced to its full capacity because all the conditions were the best and the train was not heavy. Tests have been made which indicate that the maximum evaporation of a boiler is about 15 lbs. per sq. ft. of heating surface per hour, and in view of this fact the above figure of 21.1 lbs. seems large. This may be the case, but we know that in the recent high-speed trials at Zossen in Germany a horse-power of 1800 is reported for a train of 250 short tons at a speed of 79.5 miles per hour.

The confusion among the train resistance formulæ is shown by the following table for 80 miles per hour, the resistance being given in lbs. per ton of 2,000 lbs.:

Formula.	Conditions.	Resistance, Lbs.
Wellington	Engine and train	39.3
Baldwin	(47 to 77 miles per hr).	17.5
Barbier	Bogie coaches	18.5
Barbier	Engine and tender	38.6
Sinclair		18.9
Aspinall	Bogie coaches	25
Barnes	Engine and train	13.5
Meth. used above	Engine and train	29

So far as the cylinders are concerned, the above steam consumption is quite possible. The Class E_2 engines cut-off in the running position at 6⅜ in., and the weight of dry steam required by the displacement to cut-off, at 160 lbs. pressure, is 38,700 lbs. per hour at 338 r.p.m., or 80.5 miles per hour. If we add to this 30 per cent. of the total water consumption for extra losses, such as initial condensation, we have a cylinder consumption of 55,300 lbs. per hour.

The point of chief interest is that the boiler with 2,640 sq. ft. of heating surface can maintain an output equal to the one with 3,505 sq. ft. as shown by the above comparison. The most striking feature of the Pennsylvania boiler is the liberal water space around the fire-box and the wide throat, insuring ample circulation around by far the most valuable heating surface in the boiler. Another peculiarity of the design which may or may not affect the circulation is the placing of the injectors on the back-head and carrying the feed-water well to the front by pipes running inside the barrel. There is no ground for the assertion that a big heating surface is useless, but there is ground for question whether it is necessary, and whether the maintenance of a large number of tubes does not offset the advantage. This is very clearly stated in Mr. Vaughan's paper* on the "Value of Heating Surface," and his deductions show that the evaporation of a boiler per lb. of coal was not decreased by stopping up half the flues. The limit to the capacity of a boiler on a fast passenger locomotive is the grate area; and granting that the all-important draft arrangements are properly designed, and that there is ample fire-area through the tubes, the locomotive with a large grate and liberal circulation will prove itself a free steamer without much consideration as to its heating surface. The Class E_2 engines with their large grates are doing in the Atlantic City service what Class D_{16}, which has only 33 sq. ft. of grate, failed to do. Class D_{16} did, of course, good work in less severe service.



Speed Diagram—Atlantic City Division of the Pennsylvania.

The cry has been raised for something definite in ratios for boiler design. The chief value of ratios in locomotive design is to serve as a check on the work. A complete outfit of perfect ratios will not make a free steaming engine when the fundamental consideration of circulation is overlooked, and the engine has cracked side-sheets and other fire-box difficulties.

Alloy Steels.†

The term "alloy steels" is used chiefly to distinguish steels containing influencing quantities of metals other than iron, from the ordinary steel of commerce known as carbon steel, in which, iron and carbon are the influencing elements for use, other elements being considered more as impurities than as useful ingredients. There are three kinds of carbon steel, namely: crucible, bessemer and open hearth. They contain small quantities of phosphorus, sulphur, silicon and manganese, as well as oxygen, nitrogen and hydrogen. Copper and arsenic are present sometimes but not generally in large quantity. Small percentages of silicon and manganese are often regarded as useful for special purposes but they do not give a specific name to the steel. From time to time we have had upon the market silicon steel, phosphorus steel, chrome steel, aluminum steel, but none have been permanent. Nickel steel, manganese steel, self-hardening or air-hardening steel and high-speed steel are permanent alloy steels.

Nickel steel containing small parts of nickel is used chiefly for structural purposes, and gives strength and toughness. It has been used mostly for armor plates and gun parts, and lately it is being tested in rails.

Hadfield's manganese steel is unique, hard, tough, non-magnetic, non-hardening by quenching, non-annealable by any known method, and practically unmachineable. There is nothing to compare it to, nor to test it by. It is finding large use for a number of special purposes.

Self-hardening or air-hardening steel derives its name from the fact that when it is heated to an orange color and allowed to cool slowly in the air it becomes exceedingly hard. Some years ago it was known generally as Mushet steel, from the fact that the first development was due to the distinguished metallurgist whose name it bore. The usual composition of this steel is about 2 to 3 per cent. manganese, 4 to 6 per cent. tungsten and carbon high. The distinctive, persistent hardness of manganese steel indicates that it is manganese that gives this steel its so-called self-hardening property. This was confirmed many years ago by Langley, who found that steel high in carbon, containing about 4 per cent. tungsten and minute quantities of manganese had no self-hardening property, and that the same steel remelted so as to contain 3 per cent. manganese became an excellent self-hardening steel. Langley next showed by his emery wheel test that tungsten is the element that acts as a mordant to hold the carbon in solution at a high temperature, giving this steel its most valuable property, namely, that of remaining hard at a comparatively high temperature, so that a tool made of it could be used for cutting metals at a high speed.

Air-hardened steel, as a rule, is not tough; that is to say, if it is made tough it will not be very hard, and the edge of a tool will flow. When it is so hard that it will not flow then it is so brittle that it will crumble easily. A few years ago at the Bethlehem Steel Works, some person (whether he was a blunderer or a genius history does not say) revolutionized the whole machine business. Either by design or accident he heated a tool made of air-hardening steel until it was nearly melted, and according to the traditions and teaching of the ages the tool was ruined utterly. Again, either by accident or design this ruined tool was put into service, and it did an unheard of amount of work. This led to further experiments and tests, and the Taylor-White process was developed. This process consisted in heating a tool excessively hot and cooling it by successive stages, thus producing a tool that would cut at enormous speed for metal work, and take off chips that developed enough heat to blue them.

The process seems to have been uncertain, and the potentialities were so great that nearly all of the leading steel makers in the world attacked the problem. Manganese has reduced from 3 to 4 per cent. to 0.30 per cent to traces, tungsten has been increased to 10 to 20 per cent. instead of the usual 4 to 6 per cent., and the carbon is generally less than 1.00 per cent.

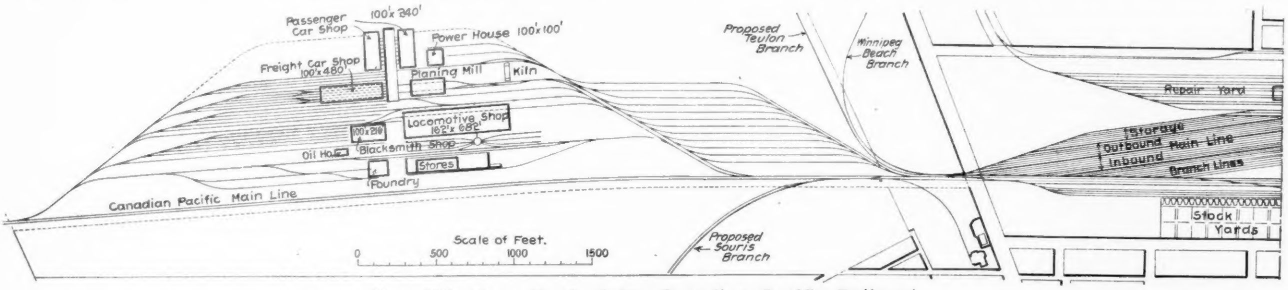
The best methods of hardening may not have been found. It seems that for very high-speed work it is necessary to nearly melt the point of a tool and quench it in a strong air blast, and then grind it to shape. This would not do for threading dies, milling cutters, etc., for the heat would destroy the tools. High-speed steel can be annealed as nicely as carbon steel, differing in this respect from air-hardening steel. The finished tools are heated in a lead bath to 1,800 degrees to 2,000 degrees, and are quenched quickly in ordinary tempering oil, which

*See *Railroad Gazette*, April 22, 1904.

†Extract from a paper read by Wm. Metcalf at the Atlantic City Convention of the American Society for Testing Materials.

must be kept cool by a coil containing circulating cold water. They are then tempered in a bath of heavy oil heated to about 450 degrees. The tools come out bright and clean.

The steel maker has the most to learn; he must find out why there is such a great difference in the work the steel will do, when there is so little difference in compositions. He must find the composition, or mixture, that will come nearest to meeting all of the requirements. As far as we know at present the steel users have not succeeded in making tools that are satisfactory for finishing, and for this purpose they use carbon steel tools. This difficulty may be overcome by proper methods of hardening and tempering or the steel makers may find a composition that will make a tool that is as good for finishing as for roughing.

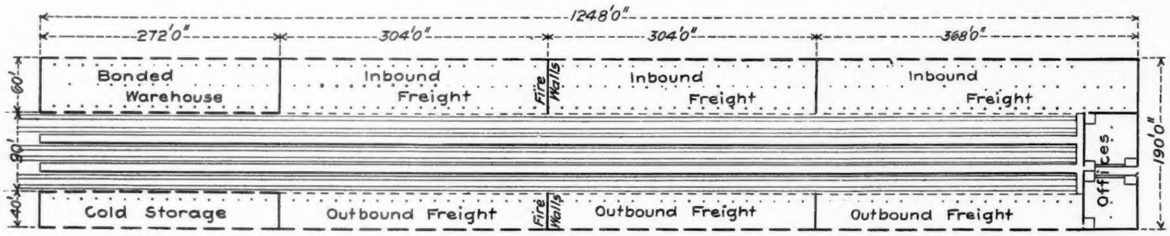


New Winnipeg Yard of the Canadian Pacific Railroad.

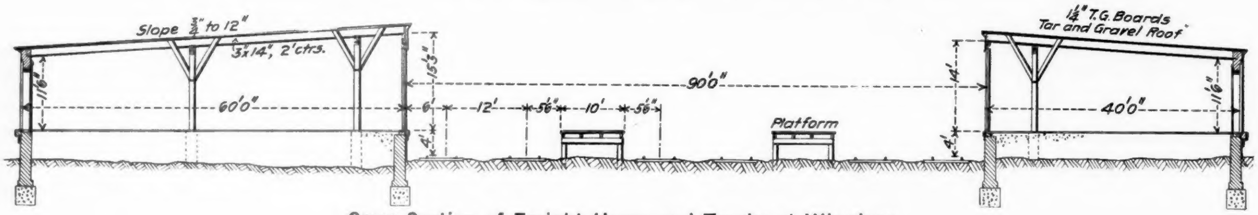
Yard, Shop and Terminal Improvements of the Canadian Pacific at Winnipeg.

The improvements now being made at Winnipeg by the Canadian Pacific Railroad consist of extensive changes in the main yard, including the building of a number of new shops, a terminal station and hotel and the erection of an eight-track viaduct 140 ft. wide over Main street. In order to provide for the yard changes, the company purchased, in the early part of 1903, about 350 acres of land west of the present yard site. The improvements now being made in the yard are of a radical nature as the general layout has been entirely changed with the exception of the main tracks and a few of the branch-line tracks serving the industries surrounding the yard. The plans provide for two combination receiving and classification yards for branch and main-line traffic which are connected by means of two "hump" tracks. Each yard contains six in-bound and six out-bound main tracks, nine branch-line tracks, six storage tracks and three independent running tracks. The yard is arranged with the engine shed, stand pipe, coal chutes and ash pit in the middle, and all freight is classified over the hump tracks. This system of having all the facilities convenient to the point where the engines are engaged will save a large amount of time and money. Other interesting and economical features are the arrangement of the weigh scales, which are on a descending grade, thus allowing cars to be separated and weighed by gravity without rehandling, and an elevated caboose track situated so as to be convenient to the outlet of the classification yard, so that cabooses can be attached to out-going trains with little delay. The accompanying yard plan shows how both the local and main line traffic may easily be classified. The arrangement of the eastbound and westbound main tracks has not been changed and they run directly through the lower part of the yard. The junction of the tracks of the branch lines to Souris, Toulon, Selkirk and Winnipeg Beach has, however, been moved further west between the main yard and the new car and locomotive shops. According to the new arrangement, all the eastbound trains of both branch and main lines will pull directly into the west receiving yard. The cars are weighed in passing over the hump and are then classified on the main and branch line tracks in the eastern half of the yard. The same operation reversed will take place with the trains from the east, which are classified in the western half of the yard. In connection with these yard changes, new car, locomotive and other shops are being built to the west of the main yard. The new buildings include two passenger shops 100 ft. x 240 ft., freight-car shop 100 ft. x 408 ft., planing mill 100 ft. x 216 ft., power house 100 ft. x 100 ft., locomotive shop 162 ft. x 680 ft., blacksmith shop 100 ft. x 216 ft., foundry 100 ft. x 100 ft., and a stores building 85 ft. x 260 ft. with a 200-ft. platform and offices above. Some of these buildings are nearly finished and all are under construction.

In the main yard proper, a new engine house and freight sheds are now being built. The engine house is of fireproof construction throughout, with walls of masonry, brick and concrete and with roofs of concrete and steel supported on steel posts encased in concrete. It contains 42 stalls divided into four sections by brick fire walls. The turntable pit is 71 ft. 6 in. in diameter, and the inner wall is 95 ft. 2½ in. from the center of the pit. The depth of the roundhouse is 80 ft. The outer door and roof supports are made of steel and are 13 ft. 7 in. from center to center at the front circle, diverging to 25 ft. at the outside walls. The pits are 58 ft. long and 4 ft. wide. The walls and footings are of concrete and the floor is paved with hard burnt brick on an arched bed of well-puddled sand. They are from 2 ft. 4 in. to 2 ft. 8 in. deep, and a catch water basin is built at the end of each pit. These basins are connected with 10-in. drain pipes graded to run to the main outlet. An easy inspection is obtained by this method and any blocking of drains can be remedied without digging or taking up the pipes. The track rails are bolted to the pit walls by wrought iron angle-shaped plate anchors placed in the concrete when the wall is built. The drop pit is built between and connects two pits and is 7 ft. wide. At the engine pits, the opening is spanned by steel I-beams so arranged that they can be removed to facilitate the handling of driving wheels. The pit is 5 ft. 2 in. deep to the first floor level and has a car track 2 ft. in gage. Under the track is an opening 1 ft. 5 in. wide and 5 ft. deep for the pneumatic jack. The roof is of concrete and steel construction and the main beams over the posts are of steel. The cross beams are built of steel rods and con-



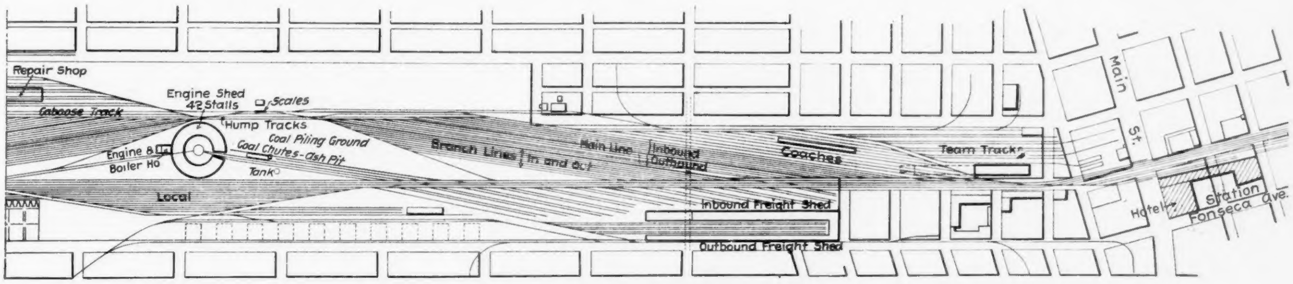
General Layout of Freight House at Winnipeg—Canadian Pacific.



Cross Section of Freight House and Tracks at Winnipeg.

crete. The posts are steel I-beams encased in concrete with a metal mesh close to the outer faces. Between the cross beams, a 3-in. slab of reinforced concrete carries the roof and a 2-in. slab forms the ceiling, the air space between serving to prevent condensation. The longest spans for the reinforced concrete beams are 24 ft. An extension is being built at the rear of the house for the engine and boiler rooms independent of the roundhouse. The engine room contains a fan engine and blower for heating purposes. carried on four rows of reinforced concrete columns. The two street railway tracks are provided for in the center archway with a clear headway of 14 ft. over the center of each track, while the side roadway arches are intended for vehicles. The roadway will have a grade of one in 20 in the approaches and will be paved with wooden blocks laid diagonally from center to sides across the street and resting on 6 in. of concrete. Sidewalks will be Granolithic 3 ft. 6 in. above the roadway and laid rails and rods. The platforms are 6-in. concrete slabs reinforced with expanded metal through which skylights are provided over each roadway and sidewalk. These skylights are removable to allow of snow being deposited and distributed on the roadways below so that sleighing will not be interfered with in winter time.

Work has not yet been begun on the combined hotel and passenger station, although the contract has been awarded to Peter Lyall & Sons, of Montreal. There will be

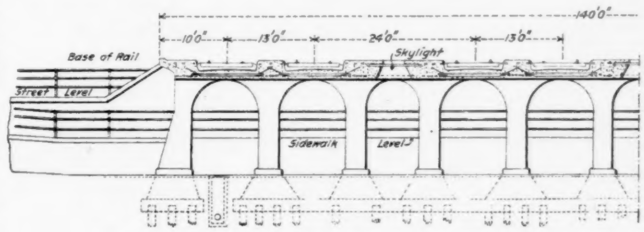


New Winnipeg Yard of the Canadian Pacific Railroad.

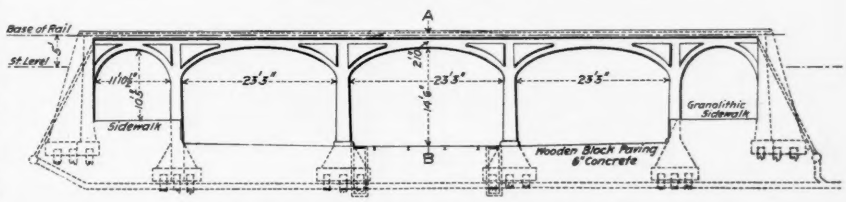
The houses are heated by hot air which is conducted through concrete and tile pipe ducts to the pits. The floor of the engine house is composed of brick with sand grout resting on a bed of well-puddled sand. The pipes from the boiler house consist of a 3-in. exhaust steam pipe with attachments to connect with the steam domes of locomotives. Exhaust steam is used for heating purposes, a 4-in. wrought-iron pipe serving for hot and cold water, and a 1¼-in. pipe being used for compressed air. Attachments and valves are provided between each pair of pits. The houses are wired for electric light and have three 16-candle power droplights per pit which are hung over the main beams between pits. Sockets for connecting handlights are provided in a convenient position on each post.

The freight houses now building consist of a two-story office 60 ft. x 120 ft., an out-bound shed 40 ft. x 1,242 ft., an in-bound shed 60 ft. x 1,242 ft. with six tracks and two transfer platforms between them. The west end of the in-bound shed is to be used as a bonded warehouse, and the west end of the out-bound shed is a cold-storage building to be equipped with a refrigerating plant. The method of construction is shown by the accompanying plan. The distance between the two sheds is 90 ft. and the width of each of the two transfer platforms is 10 ft. The height of the out-bound freight shed at the rear wall is 11 ft. 6 in., and at the platform is 14 ft., and the height of the in-bound freight shed is 11 ft. 6 in. at the rear and 15 ft. 3 in. at the front. The principal features are the long span roof beams which are cantilevered 8 ft. over the posts to carry the continuous doors. The rafters are covered with 1¼ in. boards and tar and gravel roof. The posts are supported on stone footings, and the concrete floor is laid on a prepared bed of well puddled sand.

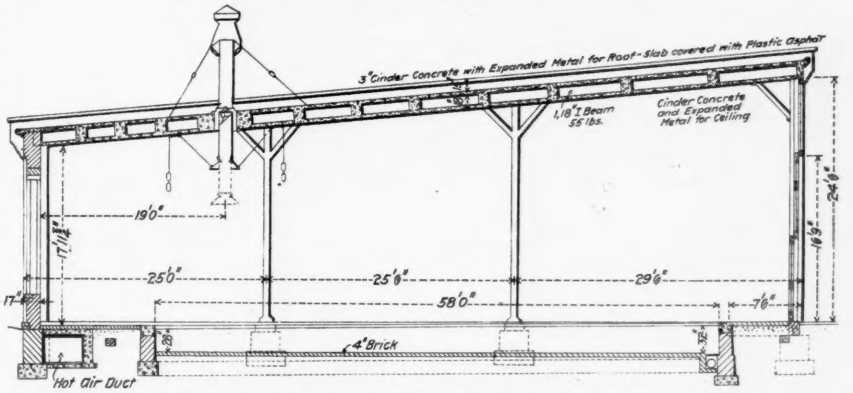
The contract for building the Main street subway has just been let to Deeks & Deeks, Winnipeg, and work on this has been begun. The tracks of the Canadian Pacific (eight in number) will be carried across Main street on a reinforced concrete groined arched structure at an elevation of 5 ft. above the present level of the street. The total length of subway and approaches is 646 ft. 8 in. and the total width over sidewalks 100 ft. The arch structure has a width of 140 ft. over copings. There are three main elliptical roadway arches of 23 ft. 3 in. clear span and two semi-circular sidewalk arches of 11 ft. 10½ in. clear span to same grade. The railroad tracks, which cross Main street on a skew of 86 deg. 4 min., are laid in depressed ballast troughs, the base of rail being 5 in. below the tops of platforms and beams. The main longitudinal beams terminate in buttresses and are reinforced with old rails latticed together, making continuous trusses between the buttresses of retaining walls. In addition to these rail trusses, other loose rails are provided on tops of beams over columns and bottom of beams in center of spans, all of which are joined together by additional shear bars hooked through holes punched in rail webs. The load is transferred to these beams by a solid concrete floor reinforced with rails and rods, the latter bent up and hooked in concrete beams at ends. The columns and footings are also reinforced with



General Plan of Main St. Subway at Winnipeg.



Cross Section of Main St. Subway at Winnipeg.



Section through Pit in Round-House at Winnipeg.

500 rooms in the hotel, which will be 240 ft. long and 190 ft. wide. The station will be 300 ft. long x 150 ft. wide, and the office portion will be 170 ft. long x 140 ft. wide. The hotel, which is to be seven stories high, will be on Main and Fonseca streets, while the offices will be on Maple street. The waiting room in the station will be three stories high, with a glass roof. The building will be built mostly of stone and terra-cotta.

We are indebted to former Chief Engineer E. H. McHenry and to F. P. Gutelius, Engineer of Maintenance of Way, for the above information and drawings.

Notes from the Union Pacific Shops at Omaha.

The new locomotive shops of the Union Pacific at Omaha were put in operation in the fall of 1902. The machine tools are driven by direct-current motors and more than 60 per cent. of the tools are new. Good results were obtained, but it was realized a year or more ago that possibilities for a considerable improvement in efficiency existed. It was decided to put the matter into the hands of one man who would devote his entire attention to bringing each important tool up to its maximum service. In some cases the output of a single tool has been so greatly increased that extra tools, previously needed, have been withdrawn from service. A few of the more notable and interesting records are given in the following:

Three pairs of 50-in. Midvale tires, which were badly worn, required two roughing cuts and were finished in 4 hours and 4 minutes, the first pair taking 1 hour and 40 minutes, the second pair 1 hour and 37 minutes and the third pair 1 hour and 27 minutes. This includes all work from the time the wheels were taken off of the floor until they were put back again. The machine used was a 90-in. Pond lathe driven by a 15-h.p. motor. The average surface speed was 23 f.p.m., using a 3/16-in. cut and feed. The maximum power demand on the motor was 7 h.p., and the average horse-power was 4½. On the basis of these tests the horse-power of the driving motor could be reduced about one-third and still have enough power to do the work.

On this same lathe 84-in. drivers having Standard tires were turned at a peripheral speed of 28½ f.p.m. using a 5/16-in. cut and 3/16-in. feed. With these heavy cuts and feeds and high cutting speeds, a tendency to excessive vibration is developed in the machine due to the dogs being too light and the shaft too small, and an uneven chattering motion given by the large gears. Larger dogs have been designed at the shops for the purpose of reducing the trouble. It has been suggested that these difficulties can be overcome by doing away with the driving shaft, which is subjected to considerable torsional stress, and drive each face plate independently with a worm.

Before high-speed steels were introduced into the shops car-wheel tires required 5 hours for turning. This time has now been reduced to 55 minutes, the machine having been speeded up to a cutting speed of 28 f.p.m., as against 6 ft. formerly. The feeds and depth of cut have, of course, been increased correspondingly. The lathes proved to be too light in some respects for this heavier service, and they were strengthened by replacing the cast-iron pinions with soft steel.

Extended piston rods are finished from the rough forging in 7 hours. The former time was 14 hours. The average roughing speed is 5 f.p.m., with ¼-in. cut and a 3/16-in. feed. This work is done on an old New Haven 36-in. lathe that has been in service 30 years. The finishing is done on a new 38-in. Pond lathe at 90 f.p.m.

The time on piston valves has been reduced from 14 hours to 3 hours. This includes centering and turning valves of medium hard cast iron 12 in. in diameter. The work is done on a Lodge & Shipley 36-in. lathe. Roughing is done at 38 f.p.m. with a ⅜-in. cut and a ¼-in. feed. Finishing and grooving is done at 45 f.p.m.

Low-pressure cylinder bushings 30 in. in diameter are turned in 1 hour and 40 minutes on a 42-in. Pond lathe. A year ago this job took 12 hours. The speed is 32 f.p.m. with a ½-in. cut and a ¼-in. feed. The finishing cut is at 48 f.p.m. with a 1-in. feed. This includes turning and facing complete, "floor to floor."

The record for drilling flue sheets has been increased from 30 to 110 holes an hour. This has been accomplished by means of the cutter shown in the accompanying sketch, Fig. 1, which was designed at the shops.

The tool used for turning and flanging locomotive and car-wheel tires is shown in Fig. 2. It consists of a soft-steel holder having at one end the roughing tool and at the other the flanging tool, both being made of high-speed steel.

The details of an air hoist for placing air drums on locomotives are shown by Fig. 3. It consists of a 5-in. air cylinder supported upright in a framework on three wheels, provided with a tongue. The upper end of the piston rod is shouldered and threaded and carries a cradle in which the drums are placed. The rod carries a split collar which rests on the upper head of the cylinder, which is used to secure the rod at any height. A drum held in position by this hoist is shown in Fig. 4.

To overcome the necessity of machining the sliding surfaces of the cross-heads of the Vauclain compounds a cast-iron jig (Fig. 5) is used. It consists of two end-plates made of boiler plate, which are supported by two soft-steel mandrels, each having a taper part to fit the piston rod fit of the cross-head. The end plates support four cast-iron angle face-plates in the same position relative to the cross-head as the guides. The top and bottom angle-plates on each side are clamped together and hand wheels with threaded stems, inserted through the clamps, bear against the end-plates, holding the angle-plates rigid longitudinally. The cross-head is heated in a molten babbitt bath contained in a cast-iron box, and the end-plates and mandrels are heated to a uniform temperature. The resulting babbitted surfaces are of such smoothness that after a short time in service their condition is as satisfactory as if they had been milled or planed, while the time for this latter operation, amounting to 1½ hours per cross-head, is entirely saved.

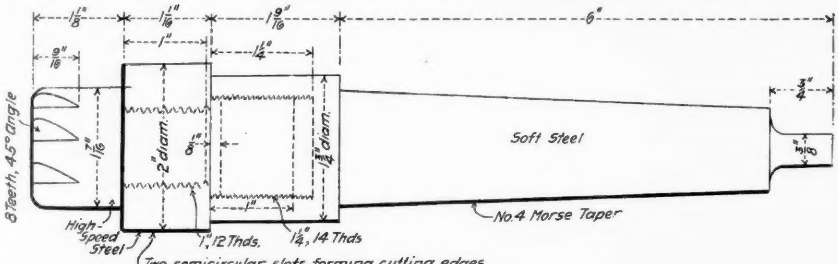


Fig. 1—Flue Hole Cutter.

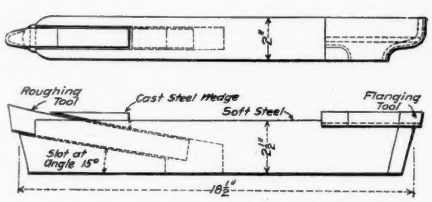


Fig. 2—Tool for Turning Tires.

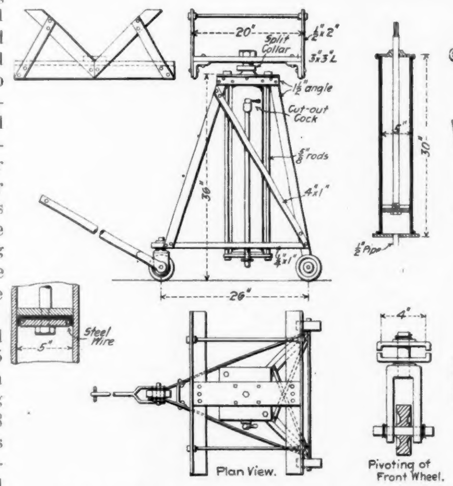


Fig. 3—Details of Air-Drum Hoist.

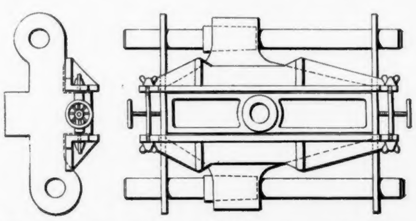


Fig. 5—Jig for Babbitting Cross-Heads.

The method of milling ports in piston valve bushings for compound engines is shown in Fig. 6. This is done with a specially designed fixture, which mills four ports at once.

By the use of knuckle pin reamers the time for reaming rods has been reduced from 2 hours to 15 minutes. In connection with the reamers is a set of templates which have been reamed out, hardened and ground, to which the reamers have been sized. The different shops along the line have been supplied with reamers, but the templates are kept in the Omaha shop, each hole having a symbol number corresponding to the reamer that has been fitted to this hole. All knuckle pins are made at Omaha, and any point along the line wanting a certain pin simply gives the symbol number.

Twenty triple valves are completely overhauled in a day of nine hours by one man and an apprentice. Fig. 7 is a corner of the brass room where triple valve work is done, showing the rack for testing the valves. One man grinds seven angle-cocks in 35 minutes. This is done on a special grinding machine (Fig. 8) that has been built up out of a nut tapper rescued from the scrap bin.

All shoes and wedges for the entire system (about 3,600 per year) are planed on the machine of Fig. 9. The time is 30 minutes per shoe or wedge, planing the surface on five sides. A special chuck was devised for this work. Fig. 10 shows an adjustable chuck that is used in planing the box face of the shoe or wedge. With a special adjustable chuck, driving box brasses are turned to fit the box (for a 9-in. journal) in 15 to 20

minutes. The former time was one hour.

Eccentrics, cast-iron, in two halves are planed up with a special jig for clamping them on the planer, at the rate of six halves an hour. The former time was two halves an hour. They are turned on a special mandrel holding four at one time (Fig. 11) at the rate of one hour each. The former time was two hours each.

The former record for boring cast-iron car

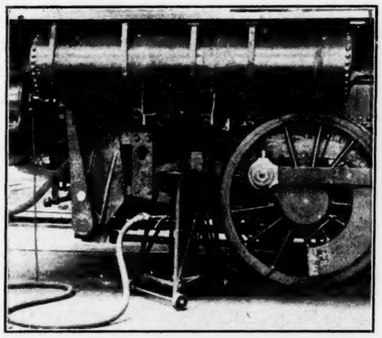


Fig. 4—Air Hoist for Air-Drums.

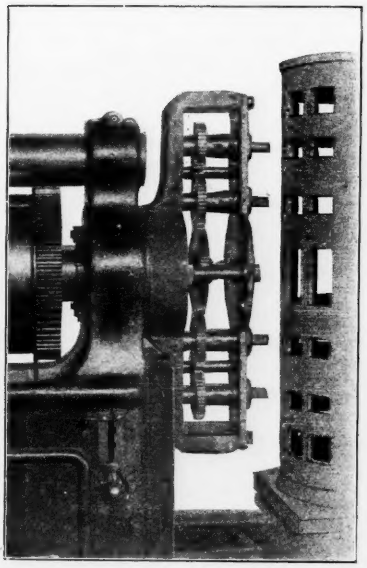


Fig. 6—Milling Ports in Bushings.

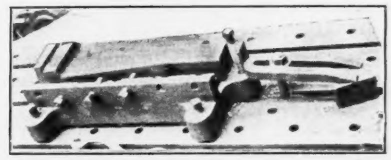


Fig. 10—Chuck for Planing Box-Faces.

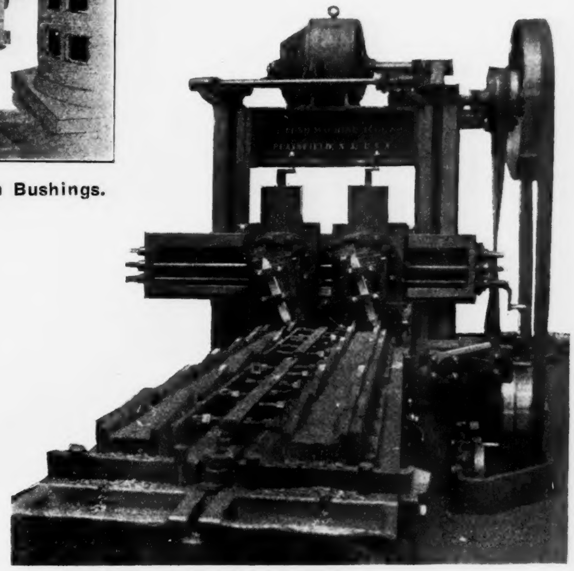


Fig. 9—Planing Shoes and Wedges.

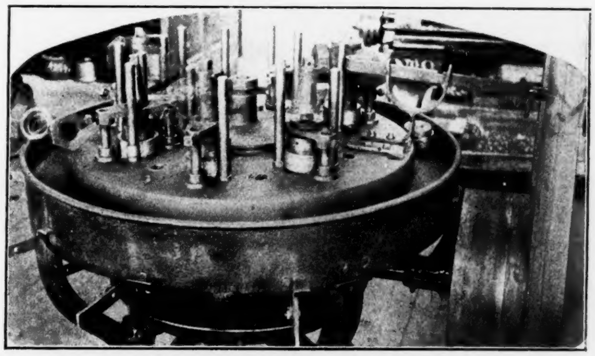


Fig. 8—Grinding Machine for Angle-Cocks.

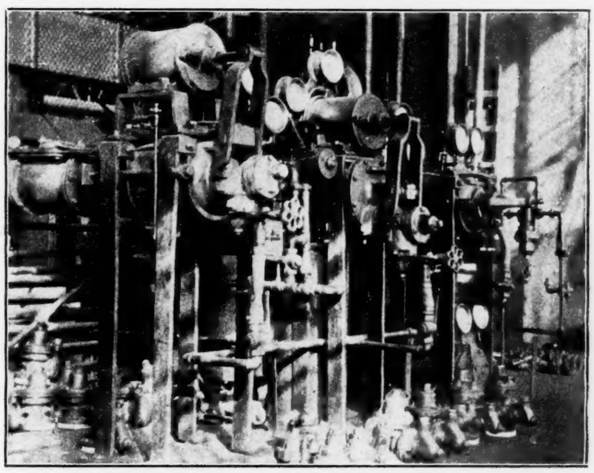


Fig. 7—Rack for Testing Triple-Valves.

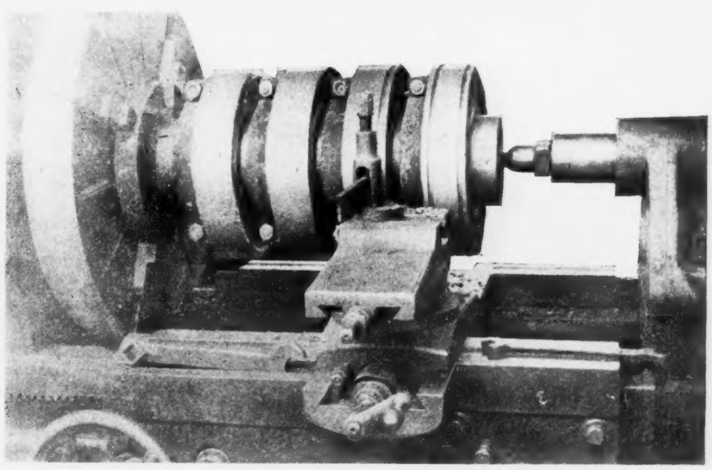


Fig. 11—Turning Eccentrics on Special Mandrel.

wheels was 50 in nine hours by one man. There is now a record of boring 90 wheels for a $5\frac{1}{2}$-in. fit in this same time, by one man, on two boring mills, using high-speed steel cutters. With a double angle-iron for clamping, and a double tool holder, eight new driving boxes have been planed up complete in 14 hours. The time with old methods was five hours per box.

One specially belted planer, to plane steel rods, runs 52 f.p.m. and removes, on actual test, 846 lbs. of metal per hour. Eighty-two-in. steel tires are bored and faced ($\frac{1}{4}$ in. stock removed) in 35 minutes. The old time with the old steel was three hours. On a Gisholt lathe, fitted up with high-speed cutters, 40 4-in. cast-iron piston rod glands have been fitted up in nine hours. On a new 24-in. Pond lathe, 60 13-in. valve packing rings have been bored, faced and cut off in six hours. A special double tool holder for slotter work enables the operator to slot out a large steel driving box complete for brass and collar fit, in $1\frac{1}{2}$ hours; old time, three hours. A special revolving angle-iron chuck, with which the brass needs but one cutting, enables the operator to plane for the rod fit a large back-end main rod brass in $2\frac{1}{2}$ hours. The time by the old method was five hours.

Other aids to rapid handling of work are the regulation of the crane service, and the narrow-gage track system. For instance, there is used with the crane a form of tackle which permits of four driver boxes being picked up and carried with safety at one time. Material is stored in special places on the platforms, and all refuse, chips, scrap, etc., are placed in bins provided for each, these bins being emptied periodically. The narrow-gage road for the most part runs by a time-table.

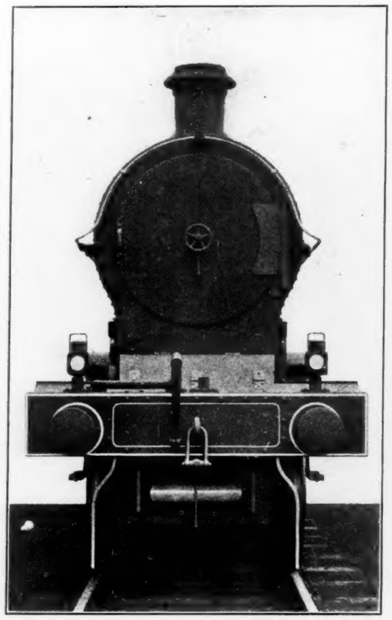
The present efficient condition of these shops has been brought about under the supervision of W. R. McKeen, Jr., Superintendent of Motive Power and Machinery, to whose suggestions many of the special methods and devices in use are due. H. W. Jacobs,

General Shop Demonstrator for the Union Pacific System, has been directly in charge of the work, developing many of the details of Mr. McKeen's suggestions. He also devised the cutter of Fig. 1 and the tool-holder of Fig. 2.

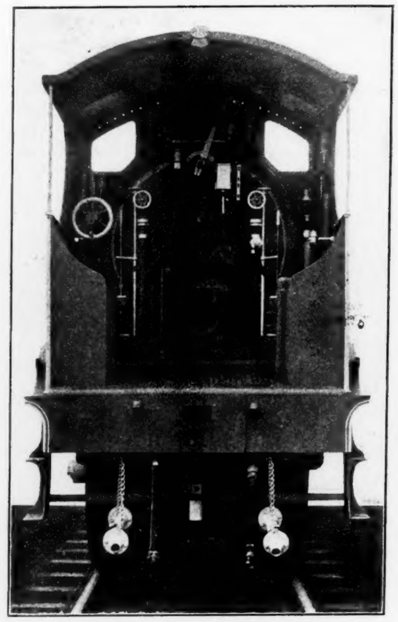
Eight-Wheel Passenger Locomotive for the London & North-Western.

The illustrations herewith show a new fast passenger locomotive designed by Mr. George Whale, Chief Mechanical Engineer of the London & North-Western. The engine was built at the Crewe works of the company. It has been designed to meet the requirements necessary for hauling the heavy and fast express trains between London, Manchester and Liverpool, and at the same time to have a reserve power to meet increased weight or speed which may be required in the future.

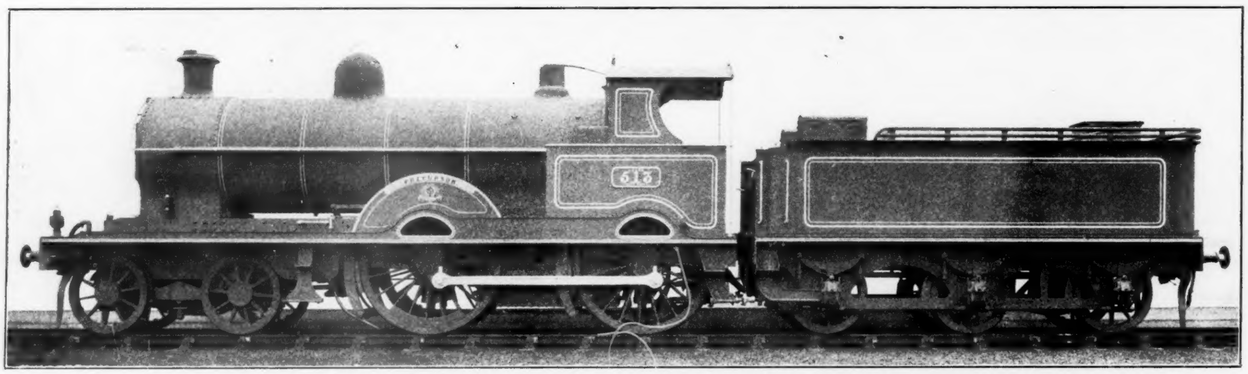
The cylinders are 19 in. x 26 in. and the drivers are 81 in. in diameter. With 85 per cent. of the boiler pressure of 175 lbs. available as mean effective pressure at starting, the maximum tractive effort is 17,200 lbs. The total heating surface is 2,009.7 sq. ft., with 161.3 sq. ft. in the fire-box. The grate area is 22.4 sq. ft. The leading truck is the



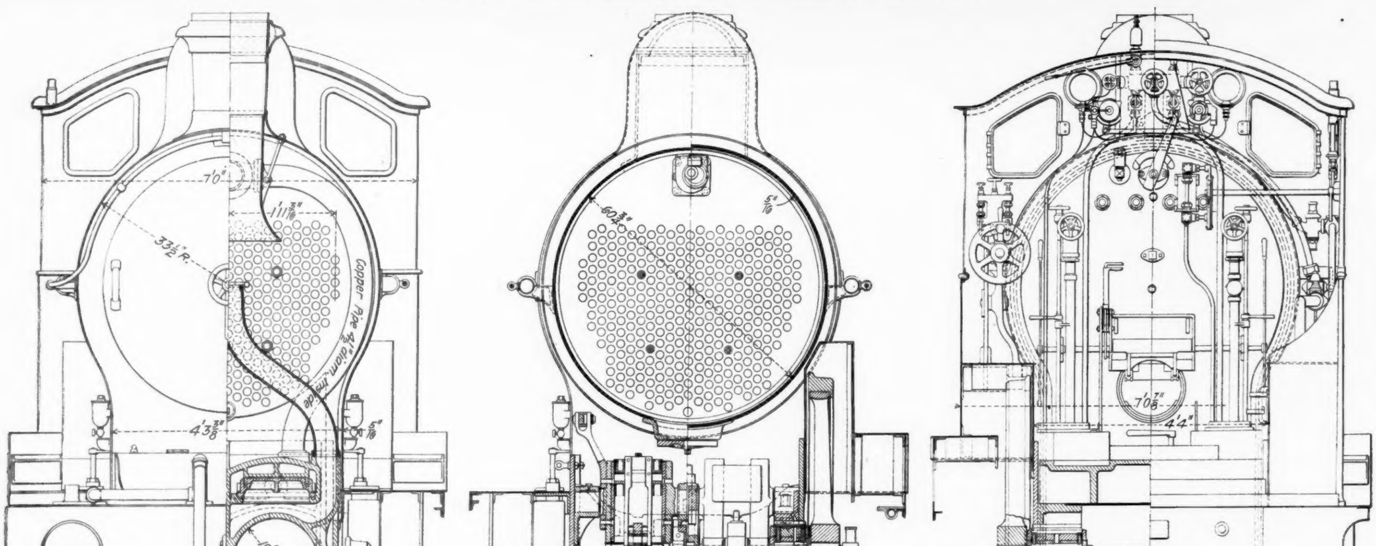
London & North-Western Locomotive.



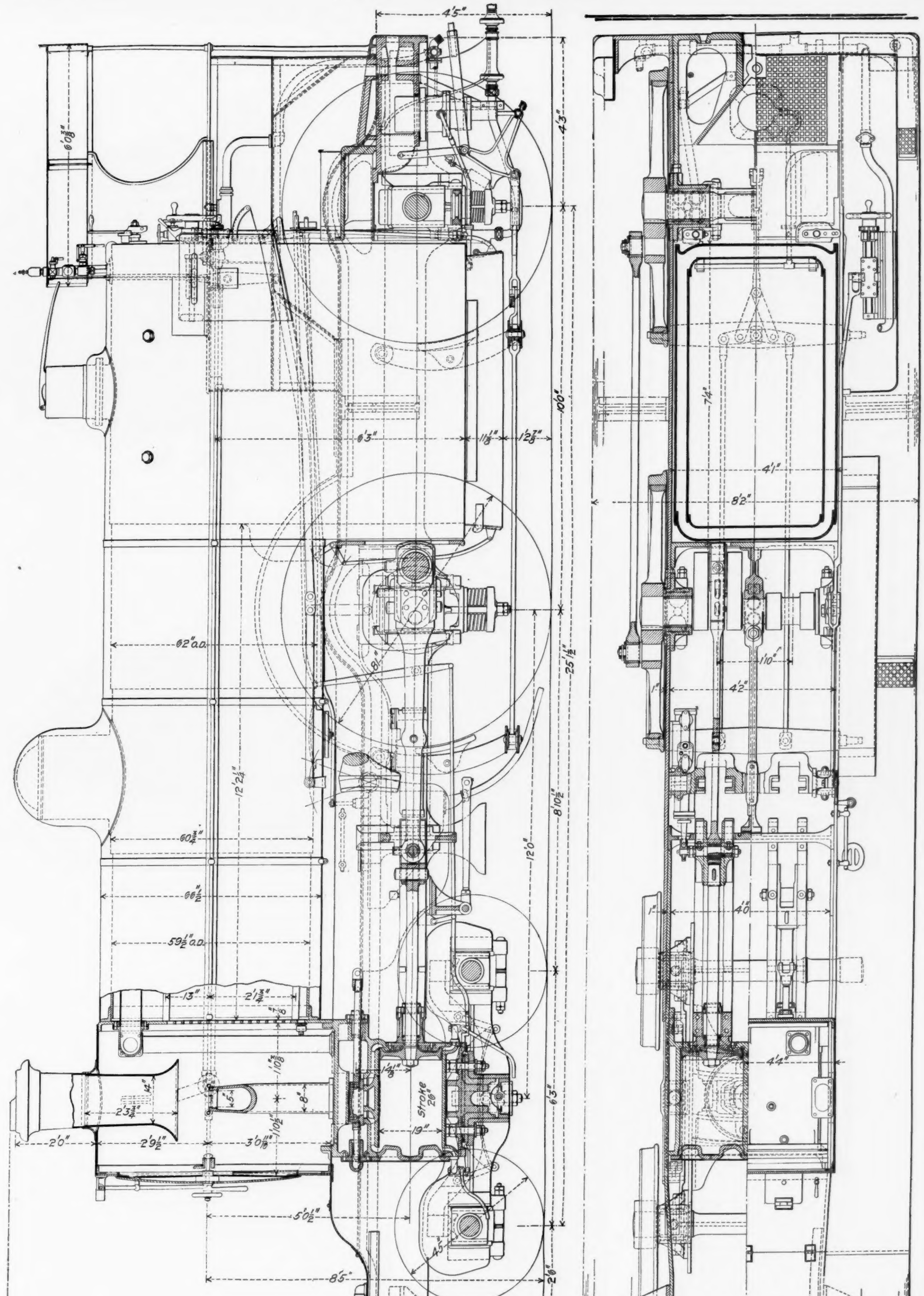
London & North-Western Locomotive.



London & North-Western 4-4-0 Type Passenger Locomotive



London & North-Western Locomotive "Precursor."



London & North-Western (4-4-0 Type) Passenger Locomotive "Precursor."

double radial type fitted at the center with a radial axle-bar, and side controlling springs. The cylinders are between the frames and have balanced rectangular valves operated by Joy's valve gear. The tender of the locomotive is made entirely of steel, which is a departure from usual practice on the L. & N.-W. The tank capacity is 3,600 gallons and the coal capacity is 6.7 tons. The tender is fitted with a water scoop operated by a hand wheel and screw. The engine weighs 133,660 lbs.

Some trial runs were made between Crewe and Rugby, and Rugby and Crewe. The train behind the tender consisted of 15 passenger cars each 50 ft. long weighing about 407 tons, and a dynamometer car weighing about 12.3 tons. The tender weighed 41.4 tons, which together with the engine gives a gross weight of about 528 tons. The trip from Crewe to Rugby (a distance of about 75.5 miles) was made in 86 minutes, and from Rugby to Crewe the time was 83 minutes, or at the rate of 54.5 miles an hour. The maximum speed attained was 75 miles an hour, but this was maintained but a short time on a 1 in 250 down grade near Crewe. The maximum tractive effort indicated by the dynamometer car was 15,948 lbs. in starting from Rugby.

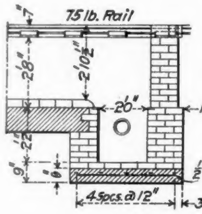
We are indebted to Mr. Whale for the drawings, photographs and details.

Reinforced Concrete Roundhouse for the C., M. & St. P.

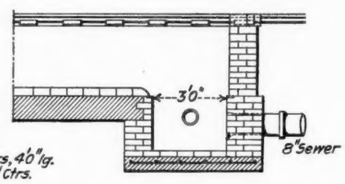
The Chicago, Milwaukee & St. Paul has begun the erection at Galewood, Ill.—a suburb of Chicago—of a roundhouse having reinforced concrete pits and lower walls. Resort to a special design was necessitated by the soil conditions of the site, which is on made ground of a depth of about 15 ft.; the alternative to the course adopted being a liberal use of piling.

The house will contain 36 stalls and is built on a radius for the inside circle of 86 ft. 10 in., and a stall depth of 84 ft. It is separated into three equal sections by transverse fire walls. The outside wall and all transverse walls are reinforced concrete up to the window line, and are brick above this point. The house is polygonal, with sides 26 ft. 8¼ in. long. A beam design is used for the reinforced concrete, the beams resting upon footings 1 ft. 3 in. deep and 2 ft. 6 in. wide, on creosoted piling, 30 ft. long. There are three piles under each angle, and a single pile under each of the two intermediate points. The transverse walls have single piles spaced at intervals varying from 6 ft. to 8 ft., except at their inner ends, where the distance is reduced to 3 ft. 7½ in.

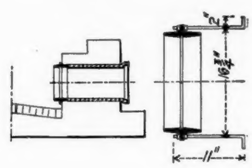
The beams are 7 ft. 7 in. deep and 15 in. thick. Their lengths vary from 6 ft. in the transverse walls to 9 ft. 6 in. in the outside wall. They are reinforced by a double row of ½-in. corrugated steel bars, placed 3 in. in from the outside and spaced 13 in. apart. There are two additional bars at the top and one at the bottom, and a single bar 3 in. from the lower edge in the middle of the beam, giving altogether 20 continuous bars. Wherever a joint occurs in construction, 12 additional bars 6 ft. long will be used, the manner of their insertion being shown in the typical sections of walls. Between sup-



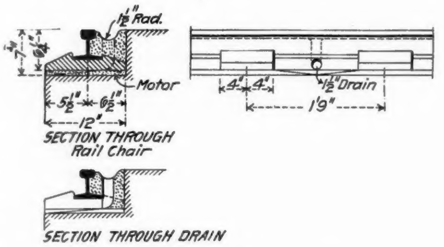
Section of 2-Ft. Catch Basin E.



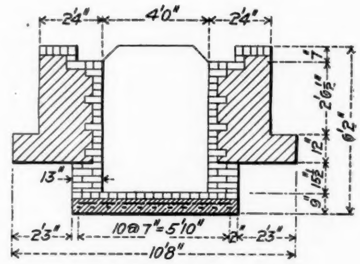
Section of 3-Ft. Catch Basin F.



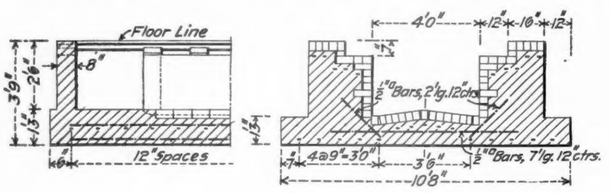
Section of Pit Showing Blast Gate and Hot-Air Pit.



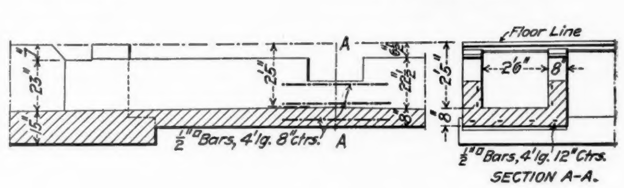
Detail of Rail Chair Setting.



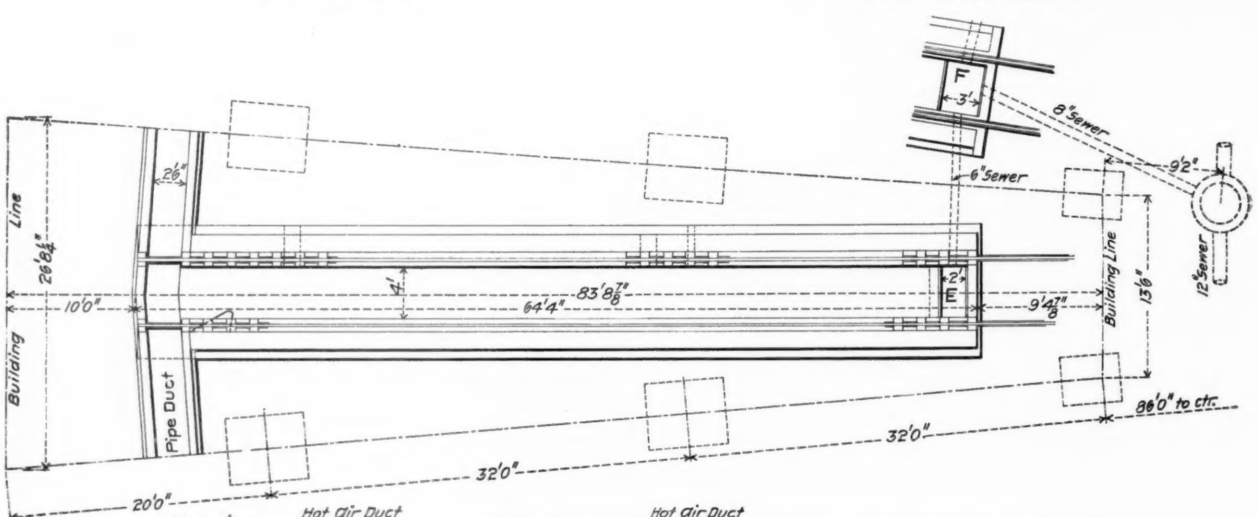
Section Through Catch Basin.

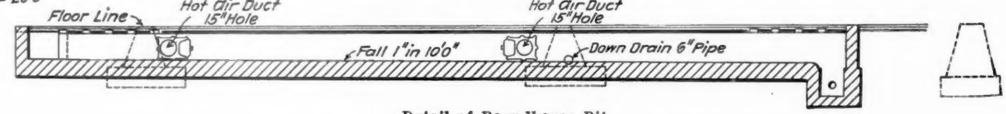


Section Through Pit.



Section Through Pipe Duct.





Detail of Roundhouse Pit.

Reinforced Concrete Roundhouse for the C., M. & St. P.

ports the bottoms of the walls are beveled at an angle of 45 deg. to a width of 3 in., the object being to reduce resistance in the event of heaving of the ground from frost. The cross-section shows a new idea in roof arrangement, there being three inclinations. The two inner ones have each a skylight to give light over the rear and middle parts of the locomotive. The ventilators have louvres and pivoted doors on each side opposite the smoke-jacks, the sides between being covered with drop siding. The smoke-jacks are tile.

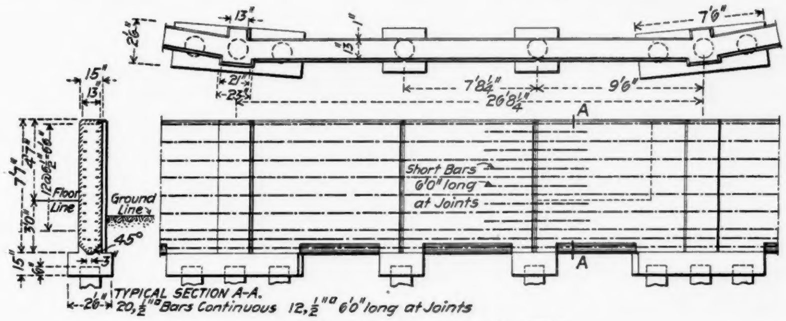
The pit design is novel. A broad base is provided to avoid the use of piling, this dimension being 10 ft. 8 in. The depth below the floor line is 3 ft. 9 in., and the thickness of wall is 2 ft. 4 in. The pit and tops of walls are lined with brick. This is due to a well founded belief that the locomotive lubricating oils would have a bad effect on the concrete. A hard-burned paving brick will be used.

The reinforcing bars of the pit concrete are clearly indicated in the drawings. At the bottom, beginning 7 in. from each edge, there are two sets of five longitudinal bars, $1\frac{1}{2}$ in. in from the lower surface, spaced 9 in. apart. There is also one set of five directly under the pit bottom, spaced 6 in. apart, and a set of five at the top of each wall. Transverse reinforcement is obtained by 7-ft. lengths spaced 12 in. centers, and the lower corners of the pit are strengthened by 2-in. lengths, placed at 45 deg. and spaced 12 in. centers. The walls of the catch-basins at the inner ends of the pits are brick. The bottoms are concrete, reinforced longitudinally and transversely as shown. The pipe duct is also of reinforced concrete. The rail chair setting, a detail of which is shown, is the standard of the C., M. & St. P. The pits have a fall toward the inner end, draining into the catch-basins. They are divided into sets of three, the one on each side draining to the center one and the latter to the sewer.

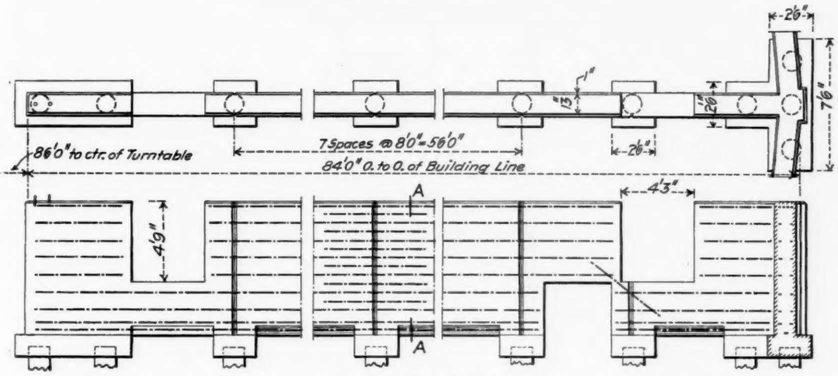
The house will be heated by the hot-blast system. The distribution will be overhead, with branches dropping down the posts to ducts running beneath tthe floor to the pits. The two outlets for each pit are placed on one side.

The estimated cost of the Galewood house, for the building alone, is \$80,000. A 30-stall house of the same design will be built at West Milwaukee, at a cost of \$65,000, and the Franklin Boulevard (Chicago) house will be enlarged by 19 stalls, also using the reinforced concrete construction. These were designed under the supervision of Mr. C. F. Loweth, Engineer and Superintendent of Bridges and Buildings. The design of the reinforced concrete work was directly in charge of Mr. J. J. Harding, Assistant Engineer. Above the concrete work the design was in charge of Mr. J. U. Nettenstrom, Architect for the company.

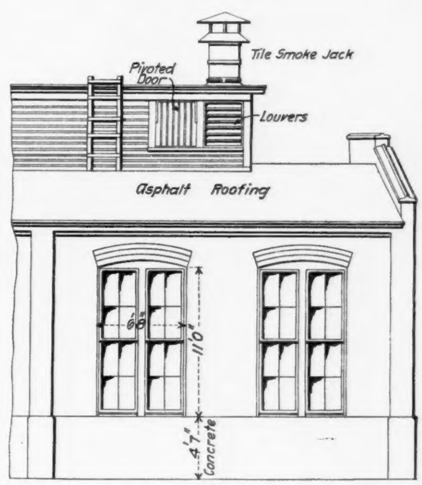
A large increase in the wages of the employes of the Chinese Eastern Railroad has been made, to last during the war. Married employes whose salary is \$450 a year or less get an advance of 50 per cent., but not more than \$180; salaries of \$450 to \$900 are advanced 40 per cent. till the advance reaches \$270; from \$900 to \$1,800 the advance is 30 per cent. till it reaches \$450, etc. Unmarried employes receive one-half of these advances. Free passes are granted to wives and children of employes who wish to return to Europe. This means that supplies are scarce and high in Manchuria. The military traffic being almost entirely eastward, passengers can be carried westward with scarcely any additional cost.



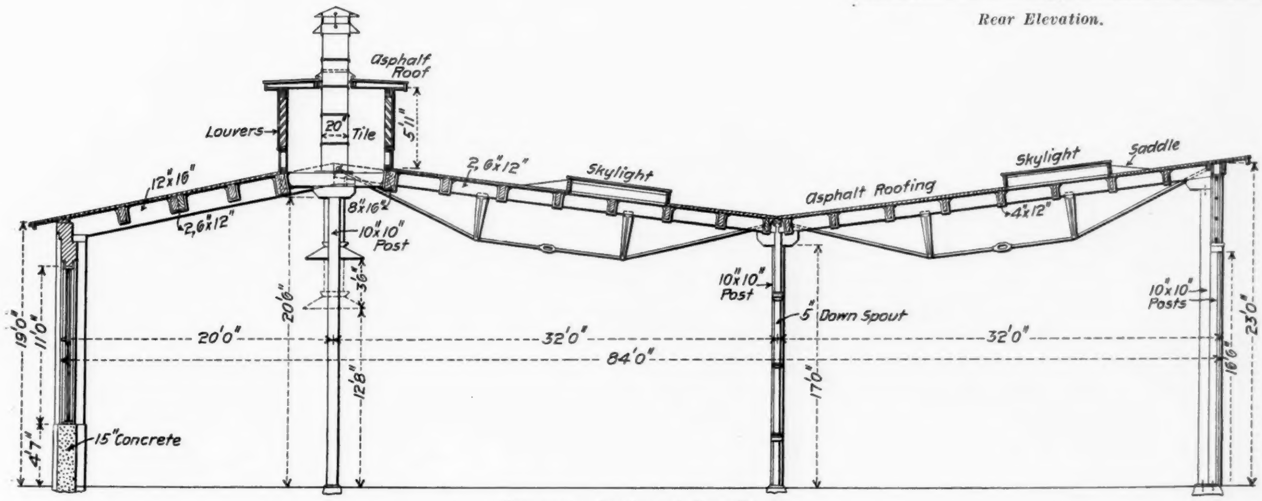
Typical Section of Outside Wall.



Detail of Fire Wall.



Rear Elevation.



Transverse Section of Roundhouse.

Reinforced Concrete Roundhouse for the C., M. & St. P.

Shop Notes from Elizabethport.

The principal repair shops of the Central Railroad of New Jersey are at Elizabethport, N. J. These shops were completed in 1901 and were described in the *Railroad Gazette* Dec. 27, 1901, and Jan. 3, 1902. The shops are modern in design and in equipment, but in addition to this, the efficiency of the shops has been greatly increased by the close attention paid to special devices for facilitating many of the operations necessary in repairing locomotives and cars. We are indebted to W. McIntosh, Superintendent of Motive Power; G. L. Van Doren, Superintendent of Shops, and others, for assistance in obtaining the details for the following descriptions:

MACHINING DRIVING BOX SHOES AND WEDGES.

Driving box-shoes and wedges are machined on a 36 in. x 10 in. double-head Pond planer, driven by a 10 h.p. motor. The chuck used for planing the inside bearing surfaces of the shoes and wedges is shown in detail in Fig. 1. The chuck is 8 ft. long and 13 in. wide over all. On the bottom of the chuck a rib is cast. This rib fits into the slot on the planer bed and prevents any lateral movement of the chuck. Two of these chucks are bolted side by side on the planer bed. Five shoes are placed in each chuck, and are held in position by ⅞ in. set screws in the chucks, as shown.

The first operation is to plane the inside faces of the shoes, shown by the dotted lines and marked "A." Both heads of the planer are used, one head on each set of five shoes, thus planing 10 shoes at one time. The second operation consists of planing the vertical sides of the shoes marked "B." Both sides are planed at the same time by using the tool "A" shown in Fig. 2. The shoes are then bolted on a planing bar, shown by Fig. 3. A parallel block is placed under each end of this bar, and the bar with the shoes attached is bolted to the planer bed. The faces of the shoes or wedges, as the case may be, marked c-c, are then planed. By using a double tool, "B" shown in Fig. 2, both of these faces are planed at one time. When these faces are planed the bar is turned over. The bar is turned by means of a crane and tackle which passes over the planer. The tackle is hooked to the planing blocks. These blocks are placed in the ends of the bar and are shown at A in Fig. 3. The faces of the shoes or wedges d-d are then planed in a similar manner to the faces c-c.

The shoes and wedges are now ready to be placed in their respective pedestal jaws to have the box faces, or face, "E" located. When the proper positions of the box faces have been found and marked, the shoes and wedges are taken to the planer and planed in the chuck shown in Fig. 4. This chuck also has a rib cast on its under side, and is secured to the planer in the same way as the chuck shown in Fig. 1. This chuck is made up of three pieces; the wedge "A," the base casting "B," and an upper hinged casting "C." The shoes, or wedges, as the case may be, are secured to the upper hinged casting, and are adjusted to the proper position for planing by means of the wedge "A." This wedge can be shifted to any desired position by means of the adjusting screws shown. In a day of 10 hours one man using this method can plane from 18 to 20 shoes and wedges. This system, tools and chucks, was designed by Mr. G. L. Van Doren, Superintendent of the Elizabethport shops.

CHUCK AND MANDREL FOR BORING AND TURNING ECCENTRICS.

The chuck used for boring and facing eccentrics is shown by Fig. 5. The lug on the bottom of the chuck is finished to fit the pocket of the boring mill. Bolts passing through the flange of the chuck hold it in position on the bed. The eccentric casting is dropped into the chuck, and is adjusted and held in its proper position by means of four set screws passing through the chuck, as shown. This device is particularly useful and economical when a number of eccentrics of the same size are to be bored. Before this chuck was used it cost about 45 cents to set up, bore and face one eccentric. By using this chuck, an eccentric can be bored and faced in 45 minutes at a cost of 25 cents. After the eccentrics have been bored and faced the key-ways are cut. They are then keyed on a mandrel, shown by Fig. 6. The method of securing this mandrel to the bed of the boring mill is the same as that used in securing the boring chuck. Two eccentrics are turned up at the same time, both heads of the boring machine being used,

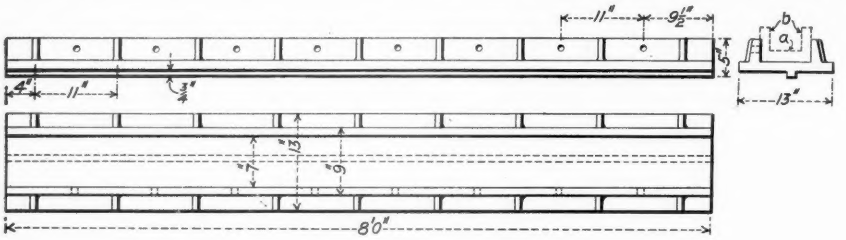


Fig. 1—Chuck for Planing Shoes and Wedges.

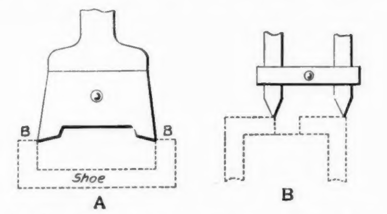


Fig. 2—Tools for Planing Shoes and Wedges.

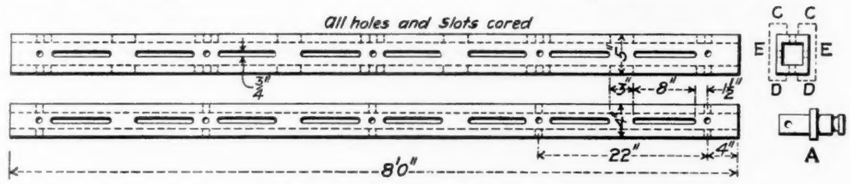


Fig. 3—Bar for Planing Shoes and Wedges.

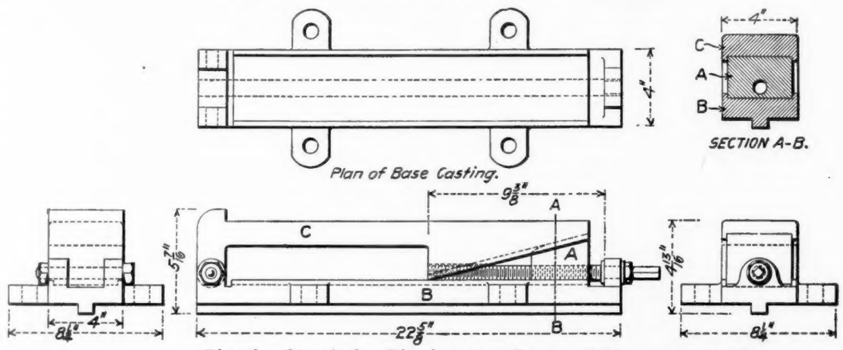


Fig. 4—Chuck for Planing Box-Faces of Shoes and Wedges.

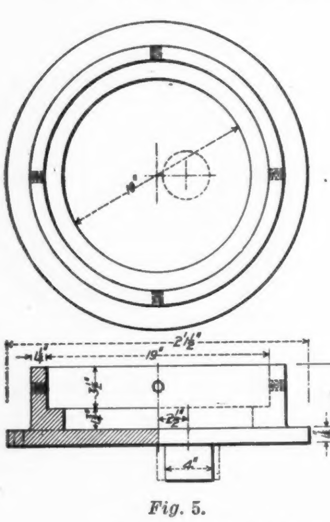


Fig. 5.

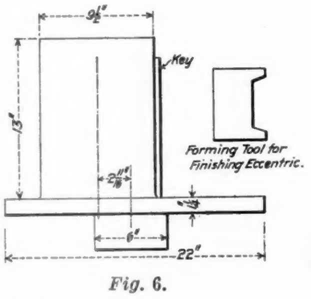


Fig. 6.

Chuck and Mandrel for Machining Eccentrics.

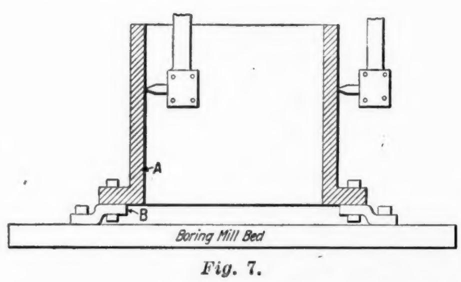


Fig. 7.

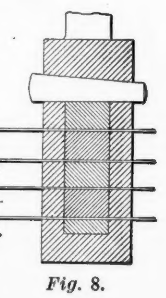


Fig. 8.

Tools for Machining Packing-Rings.

one on each eccentric. First they are roughed out with one cut by means of a round-nose tool. The finishing cut is then taken with a forming tool, like that shown in the illustration. By using this mandrel in connection with a boring mill two eccentrics can be turned up in one hour.

SPECIAL TOOLS FOR MAKING PACKING RINGS.

A cheap and rapid process for making cast-iron packing rings is shown in the accompanying illustrations. The first operation is shown by Fig. 7. The packing ring casting "A" is centered on the bed of a double head boring mill and rests on four wrought iron dogs "B," which provide clearance for the tool posts at the bottom of the casting. The casting is turned up on both sides at the same time. The cutting-off tool, Fig. 8, is then placed in the tool post. This tool is made up of four parting tools, spaced so that the rings when cut off are $^1/_{16}$ in. wider than the finished size. The cutting edges of the parting tools are stepped so that each upper tool leads each lower tool by ⅛ in. This arrangement of the cutting edges allows a clean cut through each ring and also leaves enough uncut stock in the lower rings to prevent them from breaking off before the upper rings have been cut.

Each ring is then finished in a special chuck, which is attached directly to a lathe spindle. A view of the face of the chuck is shown at "A" by Fig. 9. This chuck is made up of six segments, a, b, c, d, etc., which are expanded by a conical center. The packing ring is placed around the chuck and the segments are forced out and hold the ring in position for turning. The combination tool "B," Fig. 9, finishes both sides of the ring at the same time. The distance "A" between the edges of the cutters gives the exact finished width of the ring.

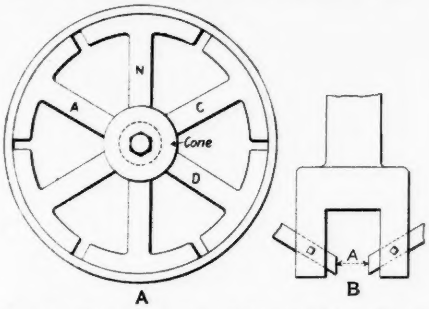


Fig. 9—Tools for Machining Packing-Rings.

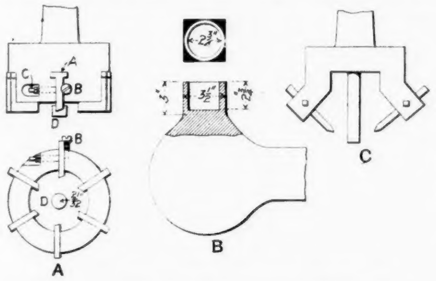


Fig. 11—Tools for Turning Oil-Cups.

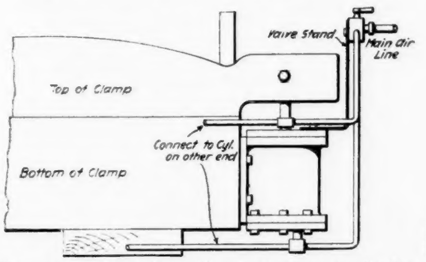


Fig. 14—Attaching Air Cylinders to Boiler Clamps.

CHUCK FOR TURNING DUNBAR CYLINDER-PACKING.

Dunbar packing is extensively used on the locomotives of the Central of New Jersey. To facilitate fitting this packing to the pistons, the shops and roundhouses are provided with a chuck, shown in the accompanying illustration (Fig. 10). These chucks are made in two sizes; one size for fitting 17 in. and 19 in. rings, and another size for fitting 18 in. and 20 in. rings. The Dunbar packing rings are all made and assembled at the main shops at Elizabethport, N. J. The rings are all made ½ in. larger than the finished size. The method of chucking the Dunbar ring is as follows. The wedge-shaped cast-iron ring "A" is placed in the position shown. The Dunbar ring "B" is then placed around the ring "A." The nuts "N" on the studs are then turned down, which, in turn, brings the wrought iron clamps "C" against the wedge-shaped ring. This wedge-shaped ring is split, and when the clamps are pulled down they cause the ring to expand and bear against the Dunbar ring and securely clamp it in position for turning.

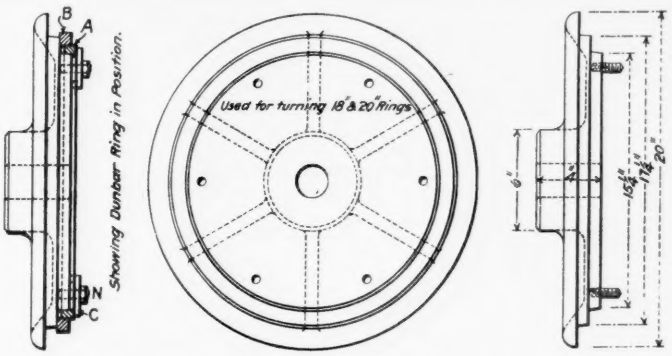


Fig. 10—Chuck for Turning Dunbar Packing-Rings.

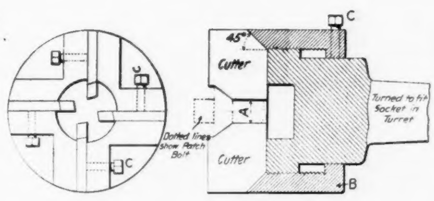


Fig. 12—Cutter Head for Patch-Bolts.

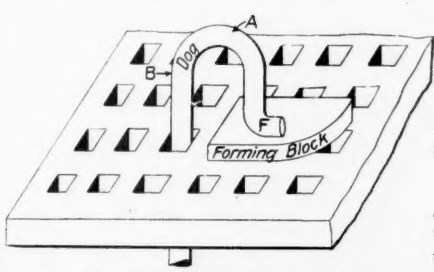


Fig. 15—Boiler Shop Block and Dog.

TURNING OIL-CUPS ON SOLID-END RODS.

The six cutters in the box tool "A," Fig. 11, are made of ⅜ in. x 2 in. tool steel and fit into the slots "A." The cutting edges are adjusted by the screws "B" and the cutters are held in place by the set screws "C." The center guide "D" is $^{31}/_{32}$ in. in diameter. This fits into a 1 in. hole drilled in the center of the solid oil cup forging "B." The oil cups are turned and bored on a boring mill, and the stock which this tool cuts away is shown by the dark shading. By using the tool the oil-cups are turned in one-third to one-quarter the time formerly needed by the old tool, shown at "C," Fig. 11. The holes in the cups are bored out by a three cutter spiral counterbore.

A CUTTER HEAD FOR MAKING PATCH-BOLTS.

An adjustable cutter head for making patch-bolts is shown in Fig. 12. The cutters are adjusted to the diameter "A" of the bolt by the adjustable collar "B." This collar is threaded to the shank of the tool. When the cutters are set to the desired position they are held in place by the set screws "C." The patch-bolt forgings are held in the chuck by the square heads. The cutter head is then brought up and with one cut finishes them the exact size. By using this tool and a screw cutting die head in the turret of a

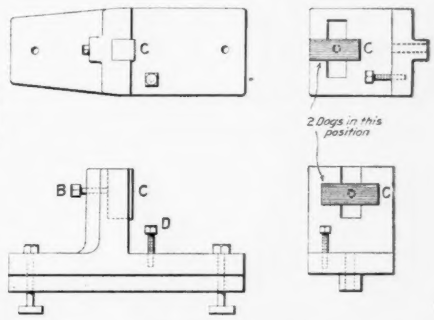


Fig. 13—Jaws for Turning Tires.

Jones & Lamsen turret lathe, 22 patch-bolts are turned and threaded in one hour.

CHUCK-JAWS FOR TURNING WHEEL TIRES.

The chuck-jaws shown in Fig. 13 are used on a 90 in. Pond double-head boring mill. There are four of these jaws in a set and they are used for chucking wheel tires. The dogs are made of tool steel. Two of these are placed in a vertical position in the jaws to prevent the tires from turning, and the other two are placed in a horizontal position to prevent the tires from rising. On the bottom of the jaws a rib is cast which fits into the radial slots in the bed of the boring mill. The jaws are secured to the bed by the bolts "A." The finer adjustment and holding of the tire is done by the set screws "B," which bear on the steel dogs "C." The tires rest on the adjusting screws "D," which also serve to adjust the tire to the proper level.

PNEUMATIC FLANGING-CLAMPS.

A pair of flanging-clamps (Fig. 14) used in the boiler shop were designed by Mr. W. McIntosh, Superintendent Motive Power. They are fitted up with a pair of old air pump cylinders. These work in unison and are so connected as to be operated by one valve. With this arrangement the clamps can be opened and closed very quickly, practically giving the sheet no time to cool. One man can operate these clamps in a better manner than two men formerly operated the old screw clamps.

A BLOCK AND DOG FOR BOILER SHOPS.

An effective block and dog (Fig. 15) was

designed by Mr. Craig, Foreman Boiler Maker of the Elizabethport shops. The block is about 4 ft. square by 2½ in. thick. It has a series of 1½ in. square holes cast through it, which are about 2¾ in. center to center. The dogs are made of 1¼ in. round iron, shaped as shown. To secure a piece of work, the dogs are placed in the holes, the foot "F" is put into any desired position on the forming block, or piece to be held, and a couple of sharp blows struck on the dog at "A" holds the piece firmly to the block. It is surprising how securely the work can be held with such a simple device. A blow struck at "B" releases the dog.

Shapes of Ties.*

In seeking for new shapes of ties the first consideration should be to secure at least the same bearing surface on the ballast which the present ties have, and preferably very much more. It is believed by the writer that the present thickness of ties is one which will probably not be increased to any extent even with an increased load, and the same may be asserted of the length. Any changes which may be made will probably be in the two bearing surfaces, namely, the one under the rail and the one on the ballast. With light rails, the present bearing surface of 8 to 9 in. under the rail is necessary where ties are used without tie-plates. The broad tie gives greater bearing surface

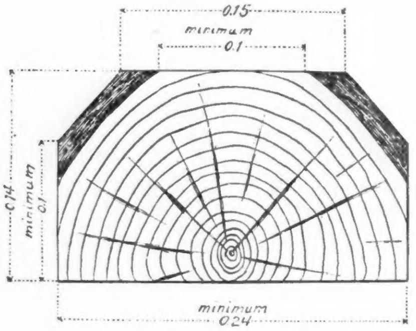


Fig. 1.

Standard tie, Bavarian State railways, suggested for use in the United States. (Measurements given are in fractions of meter.)

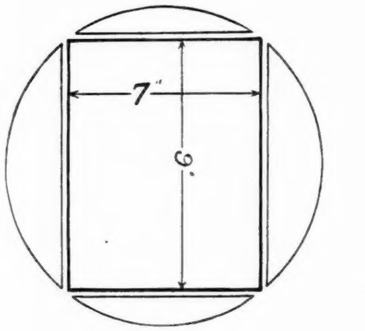


Fig. 3.

Manner of making one 7x9-inch tie from a log 11½ inches in diameter.

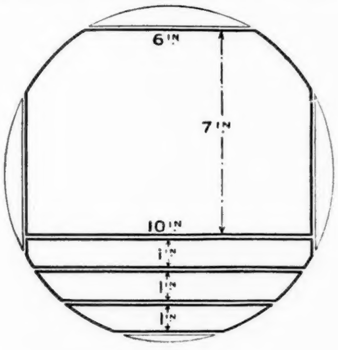


Fig. 4.

Manner of cutting one 6-inch face tie, with a 10-inch bearing surface and 7-inch thickness, and several boards from a log 11½ inches in diameter.

to the base of the rail, and greater safety to the track.

The heavier rails now coming into general use, because of their increased stiffness, no longer require the same amount of bearing surface on the tie as the lighter rails. It is generally agreed that a reduction in the bearing surface of the rail on the tie may

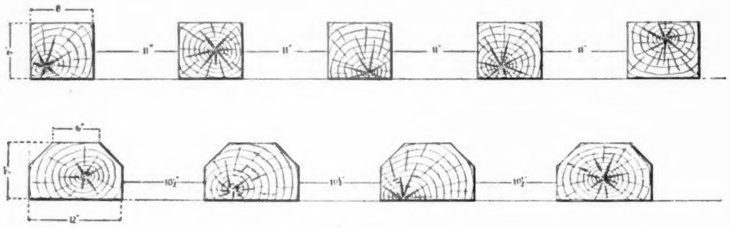


Fig. 2.

Manner of spacing 7x8-inch ties and half round ties.

be effected with safety, provided the same kinds of timbers are used as in the past. The only point which has been questioned is whether the softer timbers which are now coming to be employed—that is, timbers like red oak, loblolly pine, etc., in which the sapwood is utilized (it being taken for granted that all of these ties are treated), could be used safely with any bearing surface less than the customary 8 or 9 in. It has been generally conceded that these timbers could not be used safely without some form of tie-plate, and at the present time most of the roads which have taken up the softer timbers are actually using tie-plates of one kind or another.

While it is probable that stiffer rails will reduce the cutting action of the rail on the tie to a minimum, there seems to be no doubt that some form of tie-plate will be necessary with soft woods, even when a stiff rail is used. By using the stiffer rail, which has a broad base, the tie-plate no longer need distribute the weight, as with the lighter rails, or at least that is a minor function. Its chief function on the soft wood tie with stiff rails will be to prevent wear, and for this purpose some form of plate, either of iron or of wood, will be indispensable.

Keeping in mind the desirability of an increased bearing surface on the ballast, and the fact that the top bearing surface need be only 5 in. when a tie-plate is used, it is suggested that a type of tie with a top-bearing surface of about 6 in. and a base bearing surface of anywhere from 8 to 12 in. will not only give a sufficient bearing surface for the rail, but will also give a very much more stable tie on the ballast. Such a tie would correspond to the type shown in Fig. 1, to which may be given the name of the half-round tie. It is evident that the lines of force here have a very much greater extent on the base, and that nothing has been lost in the amount of bearing surface which the rail has on the top of the tie. This form would not only give a greater bearing surface at the base, thereby making the tie more stable, but would also permit of laying fewer ties per mile. (See Fig. 2.)

It has been admitted that with the increased stiffness of the rail it might be possible to increase the spacing between the centers of bearing of neighboring ties. If this is true, ties such as the one indicated in Fig. 1, with a top bearing surface of 6 in. and a base of 12 in., could be spaced so that the distance between the bases of two neighboring ties would be the same as for a

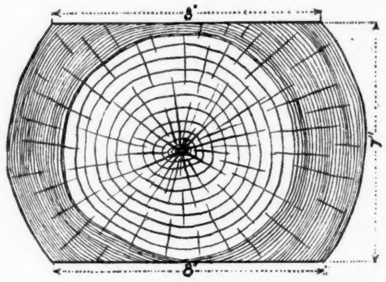


Fig. 5.

Pole Tie.

7 by 9 in. tie. This would, of course, increase the distance between the bearing centers on the top of the ties (Fig. 2.) It is necessary to space ties so as to get the same number per rail length and avoid joints. This for a 7 x 9 in. tie is about 18 per 30-ft. rail, with a space 11 in. wide between the two ties, or 20 in. between bearing centers. To avoid joints it will be necessary to space the new form so as to make either more or less than 11 in. between the extreme base joints, and, in the comparison which follows, the spacing will be assumed as 10½ in. per 30-ft. rail. (See Fig. 2.) It is by no means meant to imply, however, that such would be the actual distance in practice. It is extremely probable that 10½ in. would be too close together to allow of a proper use of the shovel or other tool employed in tamping the tie, a point which deserves considerable attention when the question of tie spacing is being considered. It is extremely probable that the increased stiffness of the rail will permit of a spacing, with a tie of the form proposed, very much greater than is possible with the present tie.

The comparative showing of rectangular 7 x 8 in. and 7 x 9 in. ties and of ties with a 6-in. top and 12-in. base, spaced respectively at 11 and 10½ in., is as follows:

	—Rectangular tie.— 7 in. x 8 in.	7 in. x 9 in.	New tie. 6-in. top 12-in. base.
Distance between bearing centers, on both top and base of tie, in.	19	20	22.5
Increase in distance between bearing centers by use of ties of the new form, in.	3.5	2.5	...
Total number of ties per mile	3,242	3,168	2,816
Number of ties per mile saved by use of new form	426	352	...
Total linear bearing on ballast per mile, ft.	2,161	2,376	2,816
Bearing surface on ballast per mile, with 8-in. length, sq. ft.	17,290	19,008	22,528
Gain in bearing surface by use of tie of the new form, sq. ft.	5,238	3,520	...

*From Hermann von Schrenk's report to U. S. Department of Agriculture, Bulletin No. 50.

According to this table the number of ties of the new form required per mile is 352 less than with the 7 x 9 in. tie, and 426 less than with the 7 x 8 in. tie, while the amount of bearing surface obtained is greater by 3,520 sq. ft. than that obtained by the 7 x 9 in. tie—an increase in bearing surface of over one-sixth. At the same time there would seem at first sight to be a considerable saving from the smaller number of ties,

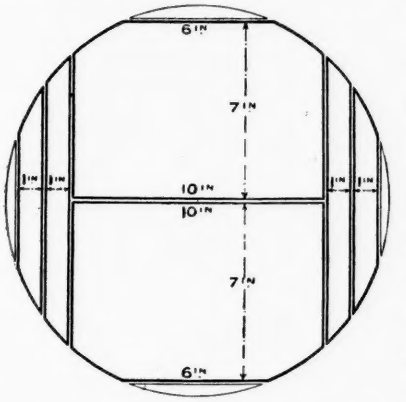


Fig. 6.

Manner of cutting two ties, with 6-inch face, 7-inch thickness and 10-inch base, as well as several boards from a log 15½ inches in diameter.

but in reality there is little difference in expense because of the larger number of feet, board measure, in the new tie.

Having shown that a tie with a smaller bearing surface at the top and a larger one at the base is a better one from a mechanical standpoint, it now becomes necessary to consider the changed tie form from a lumber standpoint. The question is, Will it be more economical to cut ties of the form just indicated than the present rectangular tie? It ought to be stated that the suggestion for the adoption of the form above specified is by no means meant to exclude the rectangular tie now used. Whenever it will pay to purchase square ties with a bearing surface of 10, 11 or 12 in., such ties will serve for all practical purposes as well as the one in which the bearing surface has been reduced to 6 in.

Ties are now being cut from trees of all diameters from 9 in. upward. If cut but one from a cross section, they are usually termed pole ties.

Most of these are rounded at the edge and squared on two sides (Fig. 3), with a required bearing surface of 6 to 8 in. Pole ties are now cut from trees as large as 17 in. in diameter. Most of them are hewn, and in the hewing much of the outer portion of the tree is wasted. In larger trees also a great deal of timber is wasted, even when ties are split in the most economical fashion. In the majority of instances no wane is admitted for a first class tie, so that logs less than 10 in. in diameter will not make ties of this class. This means that a great many tops are now left in the woods because they are too small. By adopting the tie classification suggested above (and here again emphasis ought to be laid upon the fact that ties cut according to this shape will all be treated) it will be possible to utilize a great many logs which now do not make ties, and also to cut a good many more ties out of the same amount of timber than under the present specifications. This will appear from the diagrams (Figs. 4 to 8). Fig. 8 shows a tree 11½ in. in diameter. Such a tree will make one 7 x 9 in. tie, or it will make a tie with a 6-in. bearing surface, 7 in. thick, and a 10-in. base, and a number of boards in addition, as shown in Fig. 9. A log 15½ in. in diameter (Fig. 6) will make only one 7 x 9 in. tie, but it will make two of the suggested form (Fig. 1), while from a log 19.8 in. in diameter, which will make but two 7 x 9 in. ties, three ties, two 7 x 9 in. and one of the suggested form, can be cut (Fig. 7.)

The cutting of ties of this new form will be essentially a saw mill proposition. Where now there is a great deal of waste in hewing, if the log were sawed it would mean the obtaining of several boards on the side, as indicated in Figs. 5 and 6. The number of boards to be sawed from a tree 16 in. in diameter, making two ties, will depend largely upon the value of the timber from which the ties are made. For instance, it will pay to make as many boards as possible out of a 16-in., two-tie log of red oak or gum, while with timber like loblolly pine, the lumber of which has a low value, it will at present not pay to cut off many boards. In the case of such timber an extreme form of the half-round tie will be applicable (Fig. 8.)

The influence which the new tie form will have upon the size of trees cut for tie purposes ought to be a marked one. It certainly would discourage the cutting of pole ties to a very considerable extent. It would not pay to make a tie out of a small tree when by leaving it for a few years two ties could be made from the same tree. In other

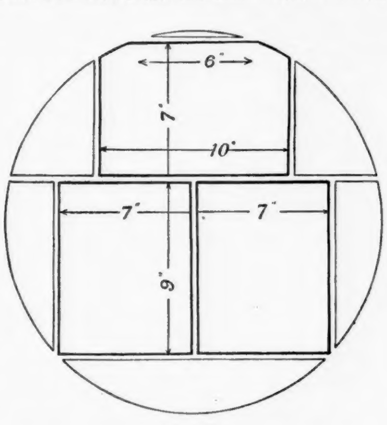


Fig. 7.

Manner of cutting ties from a 20-inch log.

words, the present policy of cutting trees 11 or 12 in. in diameter would be found less profitable than cutting trees 16 or 17 in. in diameter. There is probably no other branch of the lumber industry in which so many small trees are annually destroyed and the possible regrowth of forests retarded to such an extent as in the manufacture of ties. The practice of sawing ties from logs is going to be more and more prevalent as the old feeling that a sawed tie is not worth having disappears. This feeling is already rapidly disappearing. It certainly will disappear entirely when railroad men realize that with a chemically treated tie it makes no difference whether it be sawed or hewn. With increasing permanency in the source of supply it will pay more and more to put up small sawmills, which will saw ties and such lumber as may incidentally come to them. This will be particularly true in regions where there are rapidly growing tree species, such, for instance, as loblolly pine. The cutting of these trees will, moreover, make possible the use of large quantities of timber which now is practically wasted and from which the lumberman has no return. This is particularly true of tops.

Fig. 6 shows the manner of sawing two half-round ties from a log 15.3 in. in diameter. Such a log will make only one 7 x 9 in. tie, but it will make two of the 6 x 7 x 10 in. ties. The 7 x 9 in. tie measures 42 board ft., and the boards on the side 55 ft., a total of 97 board ft. for a 15.3-in. log when sawed into a tie of the present standard shape. The same log will make two 6 x 7 x 10 in. ties equal to 84 ft. b.m. and boards equal to 17 ft. b.m., a total of 101 ft. b.m.; that is, 4 board ft. in favor of cutting the half-round ties. It must be remembered, however, that only in the rarest instances will it be possible to realize the full number of boards estimated for the ideal round tree; hence the difference between the two methods of cutting will probably be very small.

SUMMARY.

From the foregoing discussion we may make the following generalizations:

First.—It is not desirable to continue the present method of classifying ties as first class, second class, etc., and culls. Instead, an alternative classification is proposed, which substitutes a division into grades A, B, C, etc., each standing for a certain definite size. Such a classification would throw out the cull tie entirely.

Second.—It is not desirable to decrease the number of ties of the present breadth now laid per rail length, for the reason that even with an increased stiffness of rail a reduction in the bearing surface on the ballast is not warranted, in view of the fact that a larger bearing surface on the ballast is continually being sought for. In this connection it must be remembered that closer spacing of ties will not be possible, since a certain minimum space must be maintained to permit proper track work. In other words, increasing the breadth of the tie will necessarily mean a reduction in number per rail length.

Third.—Triangular ties are not desirable and ought not to be used, because they give less bearing surface on the ballast rather than more.

Fourth.—Assuming that tie-plates are to be used on treated timbers of inferior grade, it is a waste of timber to require an 8-in. top bearing surface. It is therefore proposed that the present requirement be modified so as to admit timbers having a minimum of 6-in. top bearing surface. At the same time it is proposed that the bearing surface on the ballast be increased above 9 in. to such an extent as may prove ad-

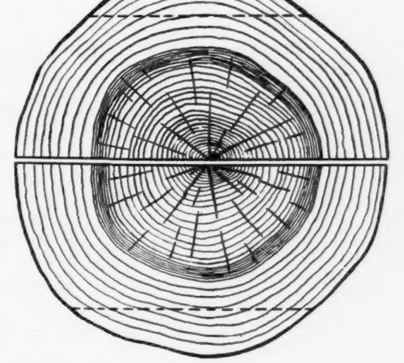


Fig. 8.

Extreme form of half-round ties cut from log of inferior lumber value.

vantageous, depending upon the class of timber from which the ties are made. This would make a "half-round tie" (Fig. 1) of the following dimensions: Top bearing surface, minimum breadth, 6 in.; bearing surface on the ballast, 10-12 in.; thickness, 7 in.; length, 8 ft. or more.

Fifth.—The half-round tie is advantageous from a mechanical standpoint, because it gives greater bearing surface per mile and

a correspondingly more stable track when spaced at approximately the same distance now used with 7 x 9 in. ties.

Sixth.—The half-round tie is good for the lumberman, because in numerous instances it will make two ties where it would have been possible to make only one of the rectangular form.

Seventh.—The half-round tie is good for the forest, because it will encourage the cutting of large trees and the saving of small ones and, further, will prevent the waste due to leaving many tops in the woods.

Eighth.—Taking all these matters into consideration, it would appear that the half-round tie is worthy of trial. Experiments are now under way to test the practicability of sawing large numbers of these ties. These experiments are being made in co-operation with the New York Central in the Adirondacks, with beech and birch, with the Santa Fé in Texas and Arizona with various pines, and with the St. Louis & San Francisco Railroad in Missouri and Arkansas and the Northern Pacific in Montana and Washington with red fir and lodgepole pine.

Programme of the Master Mechanics' Convention.

The American Railway Master Mechanics' Association will hold its 37th annual convention at Saratoga Springs, N. Y., June 27, 28 and 29. Headquarters will be at the Grand Union Hotel and the meetings will be held in the ballroom, which has been remodeled to give good acoustic properties. The following programme has been arranged:

OPENING SESSION.

First Meeting.

Monday, June 27, 1904—9:30 *a. m. to* 1:30 *p. m.*

Opening Exercises: Prayer, President's address.	9.30 a. m. to 10.00 a. m.
Intermission. Those wishing to retire may do so, but all are requested to remain.	10.00 a. m. to 10.05 a. m.
Action on minutes of last meeting	10.05 a. m. to 10.10 a. m.
Report of secretary and treasurer	10.10 a. m. to 10.25 a. m.
Assessment and announcement of annual dues	10.25 a. m. to 10.30 a. m.
Election of auditing committee	10.30 a. m. to 10.35 a. m.
Unfinished business	10.35 a. m. to 10.40 a. m.
New business—consideration of matters affecting the conduct of the affairs of the association; appointment of committees on correspondence, resolutions, obituaries, nominations, etc., and such other matters as may properly come under this order of business	10.40 a. m. to 11.00 a. m.
Discussion of report on ton-mile statistics	11.00 a. m. to 11.30 a. m.
Discussion of individual paper on grates for bituminous coal, by J. A. Carney, M. M., C. B. & Q. R. R.	11.30 a. m. to 12.00 m.
Discussion of reports on:	
Coal consumption on locomotives	12.00 m. to 12.45 p. m.
Locomotive front ends	12.45 p. m. to 1.30 p. m.

Adjournment.

Second Meeting.

Monday, June 27, 1904—7:30 *p. m. to* 9:30 *p. m.*

Topical Discussions.

1. For lubricating main, side rods and driving box bearings, which is the better practice, grease or oil? To be opened by Mr. T. S. Lloyd	7.30 p. m. to 8.00 p. m.
2. With the large modern engines equipped with power brakes, is not screw reverse mechanism preferable to present hand lever arrangement, and is quick reversal a vital consideration? To be opened by Mr. Jas. McNaughton	8.00 p. m. to 8.30 p. m.
3. What is the best practice with reference to providing air spaces under locomotive grates, especially with wide fire-box locomotives? To be opened by Mr. F. J. Cole	8.30 p. m. to 9.00 p. m.
4. What is the best method of caring for exterior of locomotive front ends from the standpoint of cost and appearance? To be opened by Mr. W. O. Thompson	9.00 p. m. to 9.30 p. m.

Adjournment.

MIDDLE SESSION.

First Meeting.

Tuesday, June 28, 1904—9:30 *a. m. to* 1:30 *p. m.*

Discussion of reports on:	
Locomotive driving and truck axles and locomotive forgings	9.30 a. m. to 10.00 a. m.
Boiler design	10.00 a. m. to 10.30 a. m.
Revision of standards	10.30 a. m. to 11.00 a. m.
Air-brake and signal instructions	11.00 a. m. to 11.30 a. m.
Piston valves	11.30 a. m. to 12.00 m.
Individual paper on machine tools. By Mr. H. H. Vaughan	12.00 m. to 12.30 p. m.
Individual paper on technical school graduates. By Mr. R. D. Smith	12.30 p. m. to 1.00 p. m.
Individual paper on terminals for locomotives. By Mr. R. Quayle	1.00 p. m. to 1.30 p. m.

Adjournment.

Second Meeting.

Tuesday, June 28, 1904—3:00 *p. m. to* 5:00 *p. m.*

Topical discussions:	
Packing for air pumps for high speed brakes. To be opened by Mr. A. J. Cota	3.00 p. m. to 3.30 p. m.
The advisability of reducing the diameter of stay bolts and shortening the space between the stay proportionately. To be opened by Mr. G. R. Henderson	3.30 p. m. to 4.00 p. m.
Leaky flues in wide fire-boxes. To be opened by Mr. M. K. Barnum	4.00 p. m. to 4.30 p. m.
Limit of width of soft coal burning fire-boxes, with reference to high evaporation efficiency. To be opened by Mr. S. M. Vauclain	4.30 p. m. to 5.00 p. m.

Adjournment.

CLOSING SESSION.

Wednesday, June 29, 1904.—9.30 a.m. to 1.30 p.m.

Discussion of:	
Individual paper, by Mr. W. R. McKeen, Jr., on tool steel	9.30 a. m. to 10.00 a. m.
Report of Master Car and Locomotive Painters' Association on painting locomotives	10.00 a. m. to 10.15 a. m.
Individual paper, by Mr. C. A. Seley, on variable motors	10.15 a. m. to 10.45 a. m.
Report on:	
Automatic stokers	10.45 a. m. to 11.00 a. m.
Locomotive frames	11.00 a. m. to 11.30 a. m.
Cost of locomotive repair shops	11.30 a. m. to 12.00 m.
Safety appliances for locomotive front-ends	12.00 m. to 12.30 p. m.
Subjects	12.30 p. m. to 12.45 p. m.
Correspondence and resolutions	12.45 p. m. to 1.00 p. m.
Election of officers	1.00 p. m. to 1.30 p. m.

Adjournment.

Water Softening on the Union Pacific.

BY A. K. SHURTLEFF.*

During the progress of the improvement work on the Wyoming division of the Union Pacific Railroad, particular attention was directed toward the improvement of the locomotive water supply, both as to quality and quantity. The conditions on the district from Rawlins to Green River demanded very careful consideration. The entire supply for the district was obtained from deep wells except at Green River and Rock Springs. These two stations were supplied by water pumped from the Green River, which is a fair boiler water. At Rawlins the water was very high in both incrusting and foaming solids, and the supply was insufficient for the needs of the company. At Point of Rocks the water was high in incrusting solids, but appeared susceptible to treatment. At the other stations the supply was limited, and while low in incrusting solids was very high in sodium salts.

After thorough investigation it was decided to build pumping stations and a pipe line from the North Platte River at Fort Steele to Rawlins. In this manner an abundant supply of water was obtained for Rawlins, carrying in solution about 6 gr. of incrusting solids and 8 gr. total solids per gallon, and varying but little from this throughout the year. To improve the quality of the water at Point of Rocks, a Kennicott water softener of 8,000 gals. per hour capacity was erected, and when placed in operation reduced the incrusting solids in this water from about 18 gr. to about 5 gr. per gallon, as shown in the table herewith. The only satisfactory method of obtaining a better supply at the Riner and Bitter Creek stations was to haul water to these points from Rawlins and Point of Rocks respectively, and this method was adopted. By thus obtaining the better quality of water at Rawlins and Riner, and treating the water for Bitter Creek and Point of Rocks at the latter point, the amount of incrusting solids going into boilers daily on this engine district was reduced about 500 lbs. Owing to the fact that the new line from Rawlins to Tipton was placed in use only five months prior to the first use of this better water, a comparison of statistics is necessarily confined to a limited time and cannot show full value on many points. A study of freight train statistics before and after the improved conditions in water supply show the following:

	Per Cent.
Increase in average monthly engine mileage	27
Increase in gross ton miles per lb. of coal	7½
Decrease in repairs of locomotives per engine mile	34

The increase in gross ton miles per pound of coal and decrease in locomotive repairs is directly due to the better water supply, and the increase in the monthly engine mileage is largely due to the same thing, but cannot be entirely attributed to this one cause. As only five months' time has been considered, the true benefits in repairs of locomotives, and possibly in reduction of locomotive fuel, are not shown in this statement.

A better idea of the reduction in expense in locomotive repairs may be obtained from the following. The length of this district is 134 miles. There are assigned to this district about eight passenger and 20 freight locomotives.

Locomotive washed out—	Before.	After.
Passenger	Each trip.	"Limited," each trip; others, round trip.
Freight	Round trip.	Round trip.

*Assistant Engineer, Union Pacific R. R.

Water changed in boilers—
3 to 4 changes, blown through boiler each trip. Each trip.

Average life of set of flues—
Passenger ....6 months....2½ years
Freight ....10 to 12 months....2½ years

Before the change in water, a great deal of trouble and expense was incurred because of tube sheets cracking between the holes, and occasionally a crown-sheet was mud-burned. No troubles of this nature have occurred since using the better water at these four points.

While treated water is used at only two of the stations on this district, the low amount of incrusting solids in the North Platte River water makes this water the equivalent of treated water so far as incrusting water is concerned. The beneficial effects resulting from the use of water containing about 5 gr. incrusting solids to the gallon at these four stations and the absolute proof that water containing the carbonates and sulphates of lime and magnesia could be treated at a very moderate cost, resulted in an order to place ten water softeners on the Nebraska division between Council Bluffs, Iowa, and Cheyenne, Wyo. The stations selected for the installation of these plants were those where the greatest amount of incrusting matter could be removed daily, based on the amount of water used in locomotives and the guarantee that the incrusting solids could be reduced to 5 gr. or less per gallon. These points are shown in the Table 1. Only about one-third of the water treated at Cheyenne is used by Nebraska division locomotives, the balance being used on the Wyoming and Colorado divisions. By treating the water at the ten stations shown in the Nebraska division table, the total amount of incrusting matter going into boilers daily on this division was reduced about 53 per cent., or 2,450 lbs., as shown in Table 2.

As the last of these plants was established in August, 1903, and three additional plants have been established on the division on a new contract during the last three months of 1903, sufficient time has not elapsed to estimate properly the full benefits of these plants. A comparison of freight train statistics for the six months ending Jan. 31, 1904, with the first six months of 1902 shows an increase of 17 per cent. in average monthly mileage of freight locomotives which is largely due to better boiler water. The locomotives spend less time in shops for repairs and in the house for washing out. The number of men at work on boiler repairs has been reduced. One motive power official, who has followed the matter closely, estimates that boiler repairs on this division have been reduced at least one-half, but it will take months and possibly years to realize fully the extent of the reduction in boiler repairs. Locomotives, which under the old conditions would have required an entire change of flues several months ago, are still running and doing good service. During the progress of the installation of these softeners close account has been kept of boiler washings. After several plants were installed it was noted that the treated water had a tendency to loosen the old scale, causing foaming at times, and at first the boilers required as frequent washing as before; but finally the monthly reports began to show a continual decrease from month to month in the number of engines washed out and a steady increase in the average mileage of engines between washouts. During the last seven months of 1903 the average mileage of locomotives on the Nebraska division between boiler washings was doubled. This means a considerable reduction in labor and cost of water for washing out, as well as increased life of boilers owing to the fact that they are less frequently subjected to the deteriorating effects of cooling caused by washing out.

In March, 1903, an order was placed for 25 additional softeners, 16 to be of 10,000 gals. and the balance 15,000 gals. an hour capacity. Five of these softeners were for the Nebraska, seven for the Wyoming, eight for the Kansas and five for the Colorado division. Of these plants, 11 are in use and the balance under construction. Table (2) shows the results being obtained from the operation of the 22 plants installed prior to March 1, 1904, and the costs of chemicals for treating the water, deduced from the actual quantities and cost of chemicals used. The last column shows the average quantity of incrusting solids removed daily in treating the amount of water used at each plant. As most of the waters on the Union Pacific carry from 2 to 3 gr. of silica per gallon in solution, no particular effort is made to reduce the incrusting solids below 5 gr. per gallon. Where soda ash is used to reduce the sulphates of lime and magnesia, the sodium sulphate in the water is increased slightly more than grain for grain of the incrusting sulphates. This means an increased tendency toward foaming. At Paxton, Neb., the water is already high in the foaming solids, hence in treating this water the carbonates of lime and magnesia are reduced to the minimum, but only enough soda ash is used to partiallly treat the sulphates of lime and magnesia so as not to unduly raise the foaming solids.

In order to get satisfactory results in the softening of water it is absolutely necessary that particular attention be given to the care of the plants and that instructions regarding their operation be carefully followed. It is necessary that frequent tests be made of the treated and untreated waters so as to keep check on the attendant and on the liability of the natural water to change. It has been necessary to use discipline at times in order to get results, as no machine can soften water without proper attention.

At a few stations where a windmill was in use in addition to the steam or gasoline pumping plants, the use of the windmill has been discontinued as it could not furnish sufficient water to properly operate the plant and thoroughly treat the water. At such stations the average cost of pumping water

TABLE 1.—NEBRASKA DIVISION—MAIN LINE WATER STATIONS.

Station.	Gallons water used per day.	Incrusting solids in one day's supply, lbs.	Capacity of softener gals. per hour.	Date softener installed.
Council Bluffs	130,000	706	15,000	May 29, 1903
Millard	30,000	82	....	....
Valley	89,000	152	8,000	Dec. 20, 1902
Fremont	60,000	143	....	....
North Bend	13,000	27	....	....
Schuyler	30,000	116	....	....
Columbus	150,000	528	10,000	Apr. 18, 1903
Silver Creek	12,000	30	....	....
Clarks	16,000	43	....	....
Central City	34,000	64	....	....
Grand Island	180,000	293	10,000	Mar. 28, 1903
Wood River	17,000	41	....	....
Gibbon	19,000	49	....	....
Kearney	72,000	168	8,000	Mar. 23, 1903
Elm Creek	10,000	36	....	....
Lexington	75,000	168	10,000	Jun. 7, 1903
Willow Island	13,000	27	....	....
Brady Island	37,000	61	....	....
North Platte	180,000	497	15,000	Apr. 27, 1903
Hershey	13,000	45	....	....
Paxton	37,000	196	....	....
Ogallala	57,000	94	....	....
Big Springs	11,000	16	....	....
Julesburg	122,000	309	8,000	Jan. 29, 1903
Chappell	10,000	18	....	....
Lodge Pole	16,000	30	....	....
Sidney	140,000	301	10,000	Mar. 16, 1905
Potter	21,000	38	....	....
Kimball	38,000	99	....	....
Bushnell	4,000	7	....	....
Pine Bluffs	38,000	84	....	....
Egbert	6,000	11	....	....
Hillsdale	18,000	42	....	....
Durham	5,000	9	....	....
Cheyenne	270,000	203	20,000	Aug. 18, 1903
Totals	1,973,000	4,733		

TABLE 2.

Results obtained at water softening plant in operation March 1, 1904, with actual costs of chemicals used, based on cost at Omaha, Neb., of lime at 90c. per barrel and soda ash at $1.07¼ per cwt.

Division and Station.	Gallons water treated daily.	Solids in solution per U. S. gal. — Before treatment — Incrusting.	Before treatment — Total.	After treatment. — Incrusting.	After treatment. — Total.	Cost of chemicals for treating. — Cents per 1,000 gals.	Cost of chemicals for treating. — Per day for water used.	Lbs. Incrusting solids removed per day.
Nebraska Division—								
Council Bluffs	130,000	38.00	47.00	4.91	34.28	2.55	$3.32	615
Valley	89,000	11.98	15.72	4.34	9.72	1.34	1.19	96
Fremont	60,000	16.70	20.52	4.84	17.37	1.05	.63	101
Schuyler	30,000	27.16	29.84	5.18	22.36	2.26	.68	94
Columbus	150,000	24.62	30.74	4.94	20.55	1.50	2.25	422
Grand Island	180,000	11.41	13.51	4.77	12.65	1.00	1.80	171
Kearney	72,000	16.35	21.68	4.74	15.02	1.07	.77	120
Lexington	75,000	15.69	21.07	4.91	12.87	1.42	1.06	115
North Platte	180,000	19.37	28.49	5.33	25.22	1.47	2.65	361
Paxton	37,000	37.10	57.17	10.95	51.19	2.55	.94	139
Julesburg	122,000	17.74	25.26	4.86	18.79	1.46	1.78	224
Sidney	140,000	15.03	16.81	4.93	15.40	.90	1.26	202
Wyoming Division—								
Cheyenne	270,000	14.19	16.65	4.56	8.47	.63	1.70	372
Cooper's Lake	47,000	20.12	28.18	4.65	17.54	1.50	.71	104
Rock River	90,000	16.81	20.63	4.99	16.15	1.00	.90	152
Hanna	45,000	14.80	15.80	4.67	8.71	1.35	.61	65
Dana	35,000	14.04	14.52	4.62	10.24	1.35	.47	47
Point of Rocks	144,000	18.05	41.79	4.26	31.52	1.50	2.16	284
Rock Springs	70,000	14.27	18.33	5.15	15.42	1.02	.71	91
Kansas Division—								
Lawrence	70,000	23.59	33.38	5.01	20.32	1.22	.85	185
Wamego	44,000	28.89	42.83	4.87	24.05	2.18	.96	151
Junction City	89,000	19.31	21.38	4.11	11.95	0.85	.76	193
Total per day	2,169,000						$28.16	4,304

Average cost for chemicals per 1,000 gals. water treated, 1.3 cents.

has been slightly increased. In a few of the cities objection has been made to having the sewer of the softener connect into city sewers. This has caused the construction of an independent sewer, and where but light fall can be obtained a considerable expense is incurred in keeping the manholes cleaned out and the sewers flushed. At points where good fall and a discharge into a regular waterway can be obtained, the expense of caring for sludge is very little.

The cost of chemicals to treat the waters varies. Each water has to be considered separately and the cost of chemicals depends on the amount and kind of reagents required for proper treatment. Common lime is used as a reagent for the carbonates of lime and magnesia, while soda ash is used as the reagent for the sulphates of lime and magnesia. As soda ash is the most expensive, water containing the sulphates of lime and magnesia is more expensive to treat than water containing about the same quantity of carbonates of lime and magnesia. Particular care is taken in the purchase of lime, and only that which is well burned and having the highest percentage of calcium oxide with the lowest amount of silica is used.

Other expense in the operation of the softeners is the labor of preparing the solutions and additional expense incurred by the testing department. At most of the plants now in operation no additional expense is incurred in preparing the solutions. This work requires not to exceed half an hour of time for each six hours of operation, and the pumpers are enabled to look after this without stopping their pumps or interfering with their other duties. At busy terminals and at points where water is obtained from city mains or by gravity, it has been necessary to make it part of the duty of some employee to prepare these solutions. In such case a proportion of his wages is charged to the operation of the plant.

At present two traveling assistants to the chemist are employed to inspect the plants and see that pumpers follow the instructions given them in regard to preparing solutions. One additional laboratory assistant is required to make weekly analyses of the water from each plant. When the entire 36 plants are in operation, the only further expense to this department will be one more traveling assistant and the additional expense for chemicals in making the analyses. At present, with 22 plants in operation, the additional expense attending softeners is $370 per month. The additional expense incurred by the testing department is $330 per month. While these are not dependent upon the amount of water treated, the cost per thousand gallons for 22 plants in operation for attendance and testing department expense is only 1.08 cents. As consumption increases at these plants this amount will be reduced. No additional expense for labor and fuel in pumping water is required, as the water is handled only once in these plants. In Nebraska and Wyoming it has been found advisable to install small heating stoves in the upper housing of the softeners to keep the plants from freezing when not in operation, during the colder part of the year.

Depreciation and repairs is an important item and was duly considered. The materials used in construction are concrete for foundations and iron and steel for the balance of the plant with the exception of the housing at the top of softeners, and a small frame building to store a month's supply of lime and soda ash at each plant. The machinery is slow and steady-moving, without jar to the structure. With these points in view the charges for depreciation and repairs will probably represent but a very low percentage of the original investment.

With the entire 36 plants in operation, having a total hourly capacity of 417,000 gals., the Union Pacific will be softening an average of 3,000,000 gals. of water per day, removing therefrom over three tons of incrusting solids. Excluding interest on investment and charges for depreciation and repairs, the entire additional expense incurred by the operation of these softeners will be equivalent to an additional charge to water supply of 2.32 cents per thousand gallons of water treated. As the consumption increases this cost will decrease somewhat, owing to the fact that some of the charges depend more directly on the number of plants in operation than on the amount of water treated. On the Nebraska division alone a reduction of 3½ per cent. in fuel used would compensate for this additional cost for treating water, and the increased monthly mileage of locomotives will more than compensate for the interest on the investment. The reduction in cost of maintenance of locomotives, less the cost of maintenance of the softening plants, is a clear saving to the railroad company.

Mr. Moseley and the Master Car Builders.*

Mr. Moseley spoke of the pleasant relations existing between the inspectors of the commission and men in the car departments of the railroads throughout the country. The recommended standards of the association are carefully followed by the commission in its criticisms of defective cars. He hoped there would be a permanent committee for conference between the association and the representatives of the government. The committee recently appointed by the Master Mechanics' Association to confer with them in the matter of handholds and steps on the front ends of locomotives settled a troublesome matter and the conference resulted in the adoption of a standard that is meeting with no serious opposition. It is possible that a similar conference ought to be held regarding a standard of construction for handholds on the roofs of freight cars. Mr. Moseley reminded the Master Car Builders that the association's standards ought to be more thoroughly promulgated, as railroad officers are sometimes found to be ignorant of them.

The law which went into effect last September requiring not less than 50 per cent. of the cars of a train to be air-braked had greatly bettered conditions. On many roads the improvement is striking. The need of high braking power is a question requiring earnest attention. The use of two air pumps on each engine hauling a long train is also an important desideratum. Cars are often cut out simply on account of insufficient air. Again, two pumps would give a feeling of security against disaster from the failure of a pump. The speaker commended the introduction of automatic hose couplings, which he had observed on some roads.

The government inspectors uniformly report that railroad officers treat them well. On the Baltimore & Ohio recently there was an extended joint inspection by two of the commission's men and one representing the railroad company. The commission desires to extend this method of inspection. It has been suggested that the government inspectors ought to mark the cars which they examine, but Mr. Moseley does not wish to thus shift the burden of responsibility from the railroad to the government. The government inspection is not for the purpose of correcting individual defects, but is for the purpose of making reports to railroad managers which will indicate general conditions.

To bring about an ideal state of equipment it is necessary to have the means for maintenance; a watchful operating department; an efficient mechanical department, and employees (trainmen) who will intelligently observe and report failures and defects. The work of trainmen and switchmen is now less hazardous than formerly, but, on the other hand, appliances are more complicated and the men need higher intelligence; a course of persistent admonition and training is necessary; the men should be able to detect defects and to repair minor ones.

The M. C. B. coupler gage can be used only when cars are separated one from another. A gage which can be used on cars that are coupled together is needed. The speaker spoke of the well-known difficulties in connection with uncoupling mechanism, and in discussing the duty of settling this complicated problem, reminded his hearers that on some roads the conditions are found to be much better than on others, where the difficulties are no less. The inspectors also find that roads usually treat their own cars better than foreign cars.

The commission has instituted suits against a number of roads for non-compliance with the law, but practically all have been settled without going through a complete trial. The commission has no desire to oppress the roads in the slightest degree, but the president and the attorney general are determined that the laws shall be enforced. The speaker referred to the Johnson case, which was decided in the Circuit Court of Appeals, affecting uniformity and interchangeability, and to the Voelker case, both of which have been reported in the *Railroad Gazette*. In conclusion Mr. Moseley said:

A matter of great importance, and one that has been brought to the attention of the whole country by the disastrous wreck which occurred on an eastern trunk line, is that of rules governing the loading of long materials. While, properly speaking, this is perhaps outside the province of the Commission, it is of such great national importance that I feel warranted in calling attention to it, and promise the aid of the Commission in securing the proper observance of any rules which may be adopted by this Association to govern the matter.

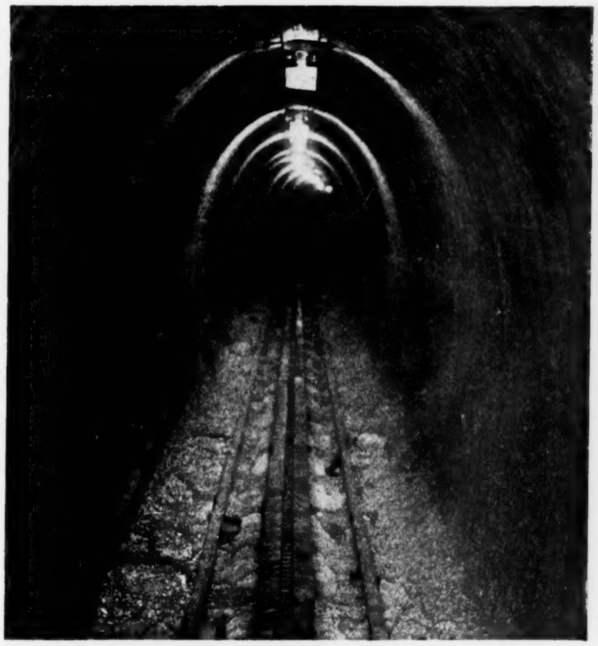
It might seem to a casual observer that the duties of your Association would decrease with the more general adoption of standards, but changing conditions indicate that your duties are to be still further increased, as new problems are constantly arising; and in this connection it has been suggested to me that some roads on which the car departments are operated entirely separate from what is known as the mechanical department are perhaps showing better results than are those roads where the two departments are operated by one superintendent. It would seem that the increased problems to which I have alluded are proving too complicated for the proper grasp of their details by any one official.

Public sentiment is rapidly becoming crystallized with regard to proper remedies for the prevention of railroad accidents, and it may be that within a measurable period of time Congress will be approached with a view to the creation of a board of experts to investigate and report on the causes of accidents, something after the plan in vogue in Great Britain. Whether this would be a desirable thing or not is not for me to say, but if it is to be avoided it can only be by associations similar to yours adopting standards which shall be followed, and using their utmost efforts to ascertain the causes of and remedies for defects in equipment.

*Abstract of an address delivered at the convention of the Master Car Builders' Association, at Saratoga, June 22, by Edward A. Moseley, Secretary of the Interstate Commerce Commission.

Cars for the Chicago Subway.

Reference has already been made in these columns (Aug. 7, 1903) to the tunnel system in Chicago of the Illinois Tunnel Company, formerly the Illinois Telephone & Telegraph Company. The latter company began the construction of these tunnels for the purpose of installing a new telephone system, but the idea was later conceived of enlarging the scheme to include an underground traction system, and accordingly last



View in Tunnel, Showing Track.

year the city passed an ordinance giving the company the right to conduct in its tunnels a freight parcels handling business, including mails, newspapers, merchandise, coal, etc. It is understood that the latter commodity will be the first to receive attention, it being estimated that the manufacturing establishments, office buildings and other consumers in the downtown district will give opportunity for carrying 4,000,000 tons of coal annually. This business will also probably include the removal of ashes from the engine rooms of these same customers. The company also expects to obtain a good part of the trucking traffic between the depots and the large wholesale and retail establishments, estimated at 125,000 tons daily.

The Morgan third-rail traction system will be used. The locomotives are a mining type, 24 in. gage, and have gears engaging a rack-rail which is laid between the track rails and is also the conductor rail. It is made of perforated metal plate ½ in. thick and 4 in. wide, and is laid between two timber stringers which support and protect it. The locomotives will weigh three tons with one motor and five tons with two motors. One advantage claimed for these locomotives is ability to haul heavy loads around sharp curves, the sharpest in these tunnels being 16 ft. radius. The Morgan Electric Machine Company, East Chicago, Ind., is the maker.

The cars to be used in this service were designed by Mr. W. P. Bettendorf. Several engravings from photographs are shown herewith, which illustrate the adaptability of the design to the different classes of service in which the cars will be engaged. The upper view shows the car complete for mail and for package delivery. Its contents may be completely enclosed and locked up. The hood is in halves, hinged to the sides, and can be removed without having to take out any bolts or nuts. Removal of the hood converts the car into a gondola. The sides are divided midway of their height, the

Fig. 1—Complete for Mail and Package Deli-

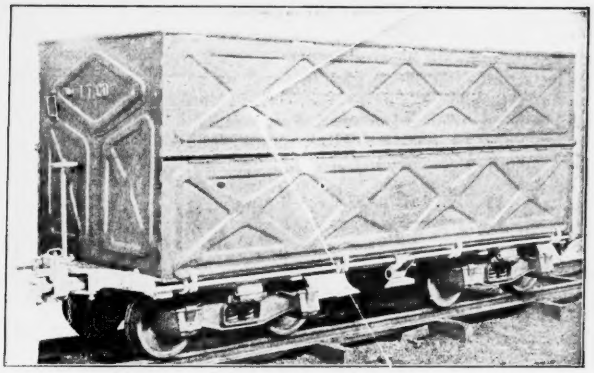


Fig. 2—As a Gondola.

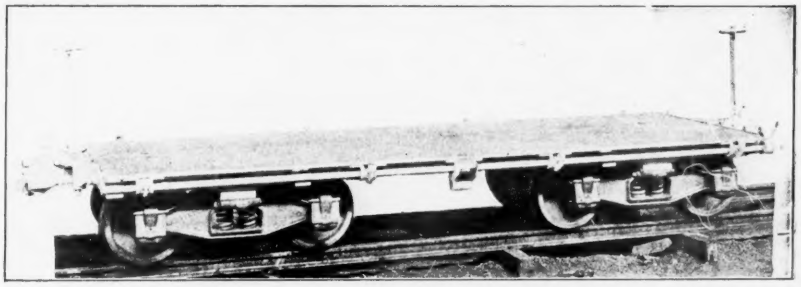


Fig. 3—As a Flat Car.

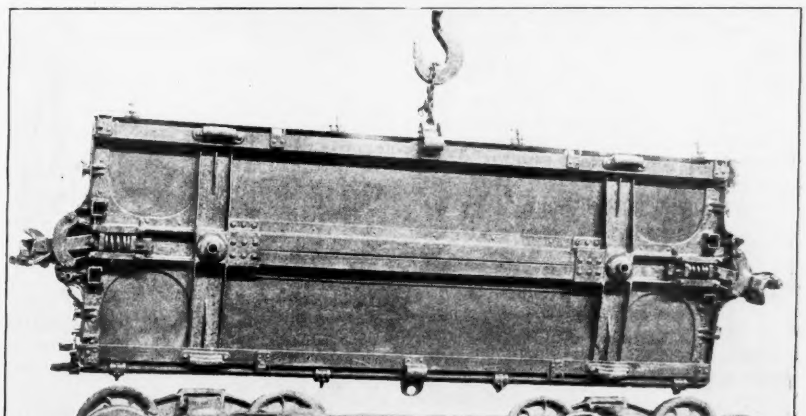


Fig. 4—Bottom View, Raised from the Trucks.

Four Views of Bettendorf Subway Car.

lower half being hinged at the top, enabling the contents to be discharged from either side. Conversion from a gondola to a flat can be accomplished in five minutes. Steel side stakes are provided for the flat cars when needed.

The cars are 10 ft. 6 in. long, 4 ft. wide, 5 ft. 1 in. from rail to top of side, and 6 ft. 7 in. to peak of hood. From the rail to the bottom of the floor is 16 in. and the height of side of the gondola is 45 in. The capacity is 30,000 lbs., and they are designed to go around curves of 15 ft. radius.

From the bottom view it will be seen that the body bolster and draft and end sills are combined in one casting. The center sills are two standard 4-in. Z bars, with their lower legs adjoining. They are riveted at their ends into pockets on the combination castings above mentioned. The side sills are also Z bars of the same size, with the lower leg extending inward. The floor is ¼-in. plate riveted to the sills and castings. The truck design is the same as that described in these columns two weeks ago, with slight modifications to adapt it to this particular service. There is no spring plank, and the truck side bearing is placed outside of the frame and is of such a form as to enable it to act both as a side bearing and a fulcrum in tipping the car body to unload it. The wheels are 14 in. in diameter and the journals 3 in. A distance rod attached to the two trucks retains them in their proper relation when the body is tipped or lifted off. To do this latter no bolts and nuts have to be removed. To provide for a condition where track cannot be laid to the unloading point, journals or lugs are cast on the end sills near their ends, to which chain bails may be attached and the entire body lifted by a hoist and run by a trolley to the desired point. In tipping for unloading, the outer lugs act as the fulcrum and form the axis about which the body rotates.

The sides are pressed steel, riveted to cast-steel stakes of T-shaped section. The cars have M. C. B. couplers and are equipped with hand brakes only. They are being built by the Bettendorf Axle Company, Davenport, Iowa, which is also building flat cars of similar design but 12 ft. 6 in. long, intended to carry the large rolls of paper used by newspapers.

Water Softening on the Southern Pacific.

BY H. STILLMAN, ENGINEER OF TESTS.

Since the establishment in 1896 of the first plant for water treatment on the Southern Pacific the system has been extended, and the method improved, so as to obtain good results without unnecessary expense in placing apparatus. As far as possible, our standard apparatus is interchangeable and can be easily moved, or repaired. The first plant established at Port Los Angeles was described in my paper before the Am. Soc. M. E. in December, 1897. The object of this article is to give a mechanical description of the apparatus.

The elevation of the small chemical house with one settling tank, which is ordinarily sufficient at stations using 30,000 to 40,000 gallons per day, is shown by Fig. 1. The water main from the pump or gravity supply passes through the chemical house where it is intercepted by a motor furnishing power to drive the small chemical pumps, and stir the chemical mixture within the chemical tank when the plant is in operation. After passing through the apparatus within the chemical house, the water which contains precipitates from treatment, passes directly into the settling tank. The old principle of drawing the settled sludge at intervals by a system of pipes at the bottom (known as a "spider drain") has, however, been abandoned, as large open ended pipes become clogged up.

The system of having a false sloping bottom dropped into the ordinary form of tank, as shown in Fig. 1, with an 8-in. central drain pipe is ample and gives no trouble. Ordinarily, it is sufficient to clean out the sludge once a month by draining the tank as low as possible into the service tank. A couple of section men make a business of cleaning out. About two hours once a month is sufficient time for sludging out the settling tank. The tank shown is duplicated at large stations. At San Luis Obispo there are four tanks, connected together and worked in pairs, the amount of water required per 24 hours being from 125,000 to 150,000 gallons.

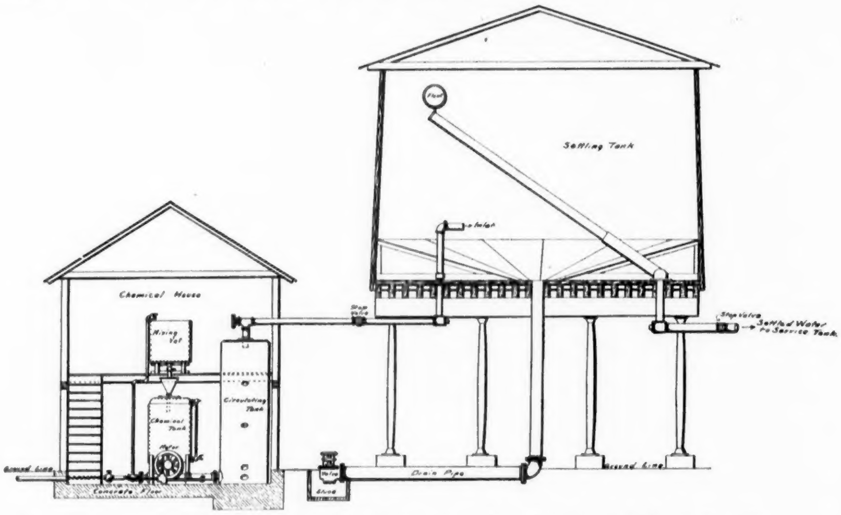


Fig. 1—General Arrangement of Water Treating Plant—Southern Pacific.

The softened water is allowed to remain in the settling tank as long as possible before the connection is opened to the service tank. The bottom of the settling tank is four feet higher than the bottom of service tank. It was formerly our practice, when possible, to treat the water directly in the service tank. This plan was abandoned, as service conditions often interfered with effectiveness of treatment. Unsettled water and sludge found their way into locomotive tenders so that independent settling tanks were found necessary. The apparatus within the chemical house is shown by Fig. 2. The chemical house also contains dry storage for chemicals. At some stations this apparatus is placed within the pump house, being arranged so that all apparatus is within easy reach of the pumps.

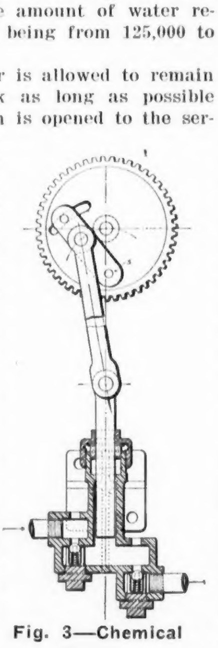


Fig. 3—Chemical Pump.

The water main is intercepted, first by the motor, which consists of an impulse wheel vertically placed within an enclosed case and driven by a nozzle at A. This nozzle can be adjusted through hand holes in the back of the motor case. On the outer projecting end of the motor shaft is a gear which drives the chemical pumps P.P.[1], and at the outer end is a sprocket wheel and chain, shown at S in the plan, for stirring the chemical mixture while feeding it from the chemical tank. In the installation shown, but one pump is used, the chemicals being mixed in one vat and fed from one chemical tank. This is at a station where temporary hardness only is to be reduced, or where the permanent hardness from sulphates, etc., requiring soda, is small. In such cases we use caustic soda* with the lime, the two oxides acting together, the caustic soda requiring less caustic lime in proportion to its affinity for carbonic acid.

Where much permanent hardness prevails, the system is made double, there being two chemical pumps, two vats and two chemical tanks. Soda ash, when thus used, is mixed in a separate vat alongside the vat shown which in this case is used for lime only. A second chemical tank is placed on the opposite side of the motor case without the stirring device which is not needed with soda solution. In some cases we have used the soda ash and lime together in one vat and found no variation in chemical results, the ultimate reactions on the raw water being the same. There are objections, however, to direct mixture in one vat of hydroxide of lime and carbonate of soda as much of carbonate of lime is directly produced, which is liable to clog the chemical pipes and pump and become hard in the chemical tank if the water is not continuously treated. We now use, therefore, a double system on bad waters.

From single or double chemical feeds, the necessary solutions enter the raw water at the cast iron box connection at B. This box has a cover for opening up the connection occasionally and removing the hard formation which will, in time, accumulate. The water now containing its necessary chemicals, passes on to the mixing tank. This tank contains no stirrer, but is arranged to stir its contents as a chemist stirs liquids in his laboratory, by using a stirring rod in the beaker of liquid and rotating the contents. This tank has four compartments, K L N and M. Compartment K is simply a sand box and receives the water directly from B. In each diaphragm which separates the tank into compartments are two

*The use of caustic soda in water treatment is quite fully discussed by Mr. H. Spencer Flynt in his article, "Some Sources of Error in Water Treatment," Engineering Magazine, Nov., 1903. Mr. Flynt advocates the use of caustic soda instead of lime where possible, on account of its being less liable to deterioration than commercial lime. We find this to be the case.

short nipples as shown. These nipples terminate in cast iron elbows or water guides which are set at an angle shown in plan, and serve to rotate the water in its upward passage through the compartment. At the second diaphragm the same water guides are set in reversed position so that the water passing M is reversed in the direction of the rotation. At the third diaphragm the water is again reversed in direction of rotation passing N.

Each compartment is provided with hand holes and the water guides of cast iron are readily detachable and removed when necessary to free them from any accumulation. Once a month this tank is drained and washed out or cleared of sludge if necessary. An extra set of water guides is at hand and inserted without delay, those removed being cleaned at leisure. With very hard waters there is a tendency for the formation of hard stony carbonate, where the caustic solutions first meet the raw water. We had some trouble with this at first, but since using the box B and removing water guides there is no trouble from this cause. After passing the circulating tank the treated and roily water passes on to the settling tank. The process described is automatic; the apparatus starting with the flow of water in the main and stopping when the flow ceases. A section of a chemical pump is shown by Fig. 3. Inverted ball valves are used in the pump to prevent sand working through with lime as is apt to occur with commercial lime.

Correct weights of lime or soda are added to the vats when the chemical tanks are filled for the day. The amount of each is suited to the mean rate of flow and the known capacities of the chemical vat and tank. At some points we have two of the automatic mixing or circulating tanks and the treatment is made strictly double, the chemical injection and mixing being separate as at Port Los Angeles. Our chemical solutions are used in condensed form, thus requiring smaller and less apparatus than usually employed in modern water treating systems that continue to use the old system proposed by Clark in England.

WATER SOFTENING ON THE SOUTHERN PACIFIC.

Miles from San Francisco.	Stations.	Source.	Average Gallons Used Daily.	Grains Per Gallon. Non-Incrust.	Grains Per Gallon. Incrust.	Incrust. Matter After Treatment.	Cost of Treating for 1,000 Gallons (Cents.)
253	S. Luis Obispo	Dug well, 30 ft.	150,000	2.45	42.22	4.20	5.1
277.3	Guadalupe	Two wells, 100 and 130 ft.	25,000	11.54	41.30	7.76	4.7
321.4	Jalama	Creek	19,330	11.43	43.16	9.33	4.5
355.8	Naples	Dug well	30,600	9.21	37.44	3.33	3.8
370.4	Santa Barbara	S. P. Co. well	20,000	12.02	26.24	9.74	3 1-3
382.5	Carpenteria	Artesian well, 125 ft.	20,000	6.24	18.14	4.37	1 6-10
399.5	San B. Ventura	Ventura River	36,000	8.40	28.21	12.14	3 1-3
416	Santa Paula	Santa Paula Creek	24,000	7.64	20.18	5.53	4
450	Saugus	New well, 228 ft.	36,000	5.43	19.18	5.77	..

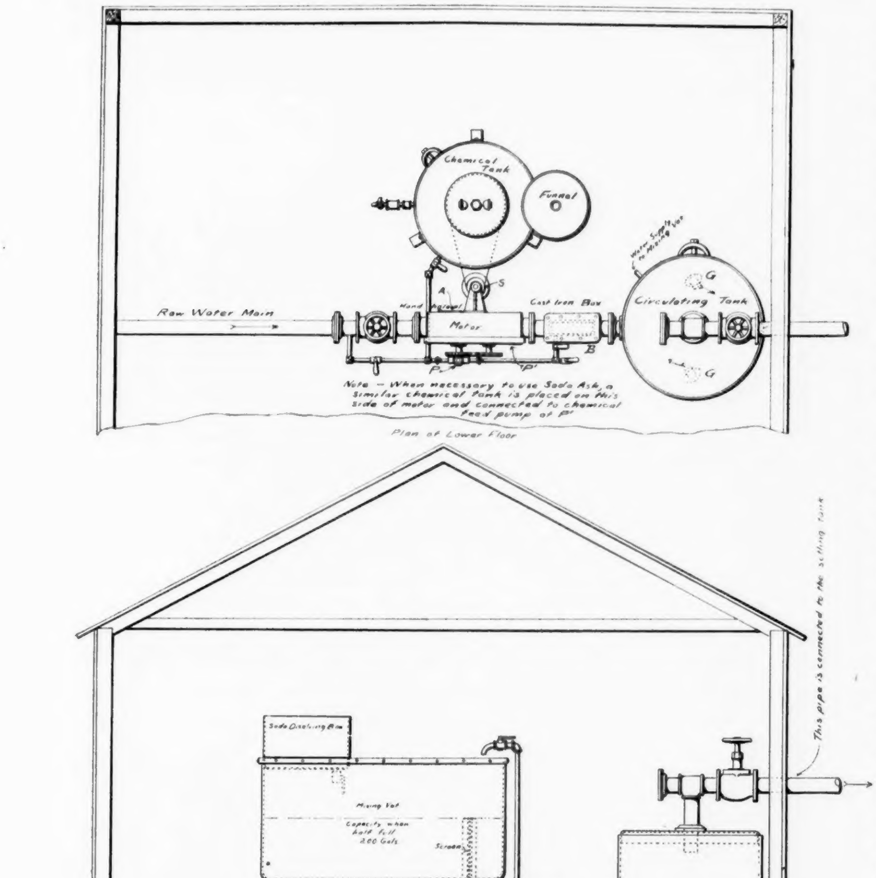


Fig. 2—Water Treating Plant—Southern Pacific.

Lime is weighed into its vat and slacked to thin white wash, which is as effective in absorbing carbonic acid as if in solution. The objection was raised when my process was first described that each particle of lime not in complete solution became coated with a carbonate, leaving an inner nucleus not carbonated. We have found by experiment that with a "half a chance" it is impossible to keep carbonic acid from combining with caustic lime or soda in the presence of water. With dry lime and carbonic acid gas such condition may, however, exist.

The mechanical method above described is, of course, varied at some stations. If, at a station the pump is above ground, and has a fly wheel, the motor is not used but an iron frame or yoke substituted that carries on either side the chemical pumps and stirring device precisely as on the motor. This gives the same automatic principle of starting the treatment with the circulation of water from the pump, and in case of gas engine pumping it is preferable to the water motor.

The process described may be summarized as follows: The system is continuous insofar as injecting and mixing the raw water with the proper chemicals is concerned. Our standard apparatus will treat from 3,000 to 12,000 gallons per hour. Properly speaking, the process is not continuous as the capacity of the plant in softened water per 24 hours is dependent on the settling tankage required. If an increased amount of water is required at any point, one or more settling tanks are put up at comparatively small expense, or they may be removed and set up elsewhere.

This process we find preferable and less expensive than a continuous process, which is not well adapted to varying conditions unless such a plant is first installed large enough to suit future demands. The complete softening of hard water involves the time element, inasmuch as it is aimed to introduce *only* the required amount of chemicals to produce reaction, without excess. We find, for instance, that the greater portion of the reaction occurs in a few seconds, but it is not completed for a long time. If an excess is added the chemical reaction is completed in a short time. Exhibitions of the chemical effect of reagents on hard water are deceptive.

Each chemical house is provided with a small chemical outfit for testing the raw

and treated water as often as an assistant, in the field, can visit the plants to adjust the formula to the varying conditions.

Some ground water is quite variable. Surface water varies much in some localities, dependent on dry or wet season.

Once a month, samples are taken at random from service tanks and analyses made at the laboratory. These results are tabulated monthly in a chart. Incrustating matter is represented by a broad line to scale, and the graphic charts are issued in blue print form. Where treating plants are established, the amount of matter removed is blocked out in red from this broad line. Analyses of the water at a number of stations on the Pacific and Coast Divisions are given by the accompanying table.

At Saugus, San Joaquin Division, we have a Kennicott continuous machine with capacity of 4,500 gallons per hour. All other points have the Stillman patent apparatus just described.

M. C. B. Reports.

SUBJECTS.

For investigation by committee.—1. The use of steel in passenger car construction.—An individual paper will be presented at the convention on this subject, but it is of sufficient importance to require further investigation by a committee.

2. Specifications and tests for bolsters, brake-beams, etc.—The Association has just installed at Purdue University, Lafayette, Ind., a drop-test machine for M. C. B. couplers. The machine is available for testing other parts of cars, and it is suggested that a committee be appointed to study the question of specifications and tests for bolsters, brake-beams and such other car details as require tests of that character to determine their strength and efficiency.

3. Grain doors.—The Central Traffic Association has suggested the adoption of a suitable grain door to meet the requirements of large-capacity cars. This subject should be investigated.

4. Flexible car trucks vs. rigid trucks.—To consider what flange wear of wheels, if any, is reduced over rigid trucks, and what difference, if any, exists as to absorption of power.

5. Recent designs of heavy trolley-car trucks.—To see if the prevailing combination of iron and wood trucks in passenger car service cannot be superseded by a lighter, stronger and cheaper all-steel truck.

6. Axles.—To investigate the practice of some roads of turning car axles so that there is a shoulder right behind the wheel hub, which hub is faced and wheels mounted to within 1/16 in. of this shoulder, it being claimed derailment will not attend a loose wheel when this practice is followed.

The report is signed by J. T. Chamberlain, chairman; C. A. Schroyer, J. S. Lentz.

CAST-IRON WHEELS.

The designs of wheels are shown by complete drawings, Figs. 1, 2 and 3. Fig. 1 shows a 600-lb. wheel recommended for cars of 60,000 lbs. capacity. Fig. 2 shows a 650-lb. wheel recommended for cars of 80,000 lbs. capacity. Fig. 3 shows a 700-lb. wheel recommended for cars of 100,000 lbs. capacity. The minimum weights allowed in interchange should be 585, 635 and 685 lbs. for the three classes of wheels. The following specifications are submitted as part of the report:

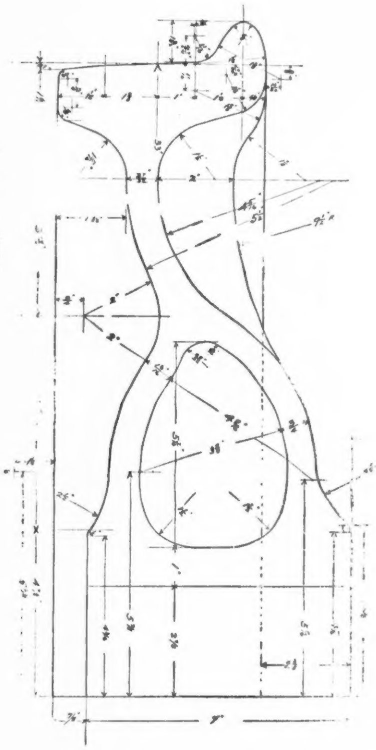


Fig. 1 —Cast Iron Wheel (600 lbs.).

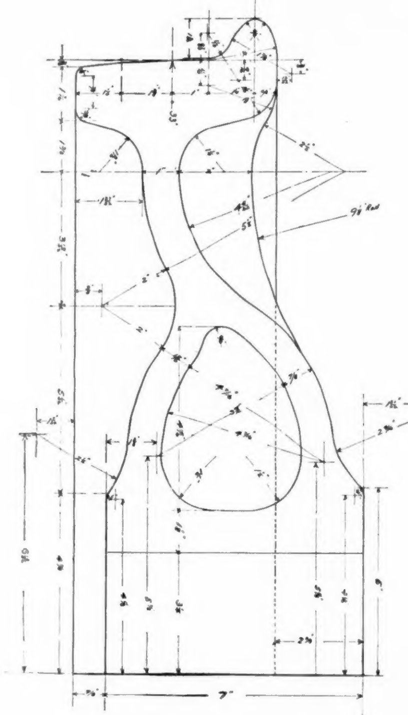


Fig. 2—Cast Iron Wheel (650 lbs.).

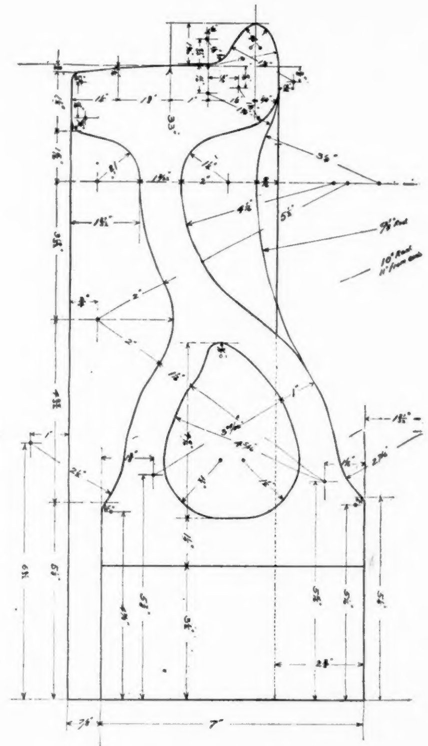


Fig. 3—Cast Iron Wheel (700 lbs.).

Specifications for 33-in. Cast-Iron Wheels Weighing 600, 650 and 700 lbs., for Cars of 60,000, 80,000 and 100,000 lbs. Capacity.

1. Chills must have the same inside profile as shown by M. C. B. drawings of wheel tread. The inside diameter of chill must be the M. C. B. standard of 33½ in., measured at a point 2⅝ in. from outside of tread of wheel.

2. Wheels of the same normal diameter must not vary more than ¼ in. above or below the mean size measured on the circumference, and the same wheel must not vary more than 1/16 in. in diameter. The body of the wheel must be smooth and free from slag, shrinkage or blowholes. The tread must be free from deep and irregular wrinkles, slag, chill cracks and sweat or beads in throat, and swollen rims.

3. The wheels must show clean gray iron in the plates, except at chaplets, where mottling to not more than ½ in. from same will be permitted. The depth of pure white iron must not exceed 1 in., nor be less than ½ in the middle of the tread, and shall not be less than ⅜ in. in the throat, for wheels weighing 600 lbs. It shall not exceed 1 in. in the middle of the tread, nor be less than 7/16 in. in the throat for wheels weighing 650 lbs., and shall not exceed 1 in. in the tread, or be less than ½ in. in the throat for wheels weighing 700 lbs. The depth of white iron shall not vary more than ¼ in. around the tread on the rail line in the same wheel.

4. For each hundred wheels which pass inspection and are ready for shipment, two representative wheels shall be taken at random, one of which shall be subjected to the following tests:

The wheel shall be placed flange downward on an anvil block, weighing not less than 1,700 lbs., set on rubble masonry at least 2 ft. deep, and having three supports not more than 5 in. wide to rest upon. It shall be struck centrally on the hub by a weight of 200 lbs. For 600-lb. wheels 10 blows falling from a height of 9 ft. For 650-lb. wheels, 12 blows falling from a height of 10 ft., and for 700-lb. wheels, 12 blows falling from a height of 12 ft. Should the test wheel stand the given number of blows without breaking in two or more pieces, the inspector will then subject the other wheel to the following test:

The wheel must be laid flange down in the sand and a channel way 1½ in. wide and 4 in. deep must be molded with green sand around the wheel. The clean tread of the wheel must form one side of the channel way, and the clean flange must form as much

of the bottom as its width will cover. The channel way must then be filled to the top with molten cast iron, which must be hot enough, when poured, so that the ring which is formed when metal is cold shall be solid or free from wrinkles or layers. The time when the pouring ceases must be noted, and two minutes later an examination of the wheel must be made. If the wheel is found broken in pieces, or if any crack in the plate extends through or into the tread, the one hundred wheels represented by the tests will be rejected.

5. In case of the drop tests, should the test wheel break in two or more pieces with less than the required number of blows, then the second wheel shall be taken from the same lot and similarly tested. If the second wheel stands the test it shall be optional with the inspector whether he shall test the third wheel or not; if he does not do so, or if he does, and the third wheel stands the test, the hundred wheels shall be accepted as filling the requirements of the drop test.

6. The lower face of the weight of 200 lbs. shall be 8 in. in diameter, and have a flat face.

7. Wheels shall not vary from the specified weight more than 2 per cent.

8. The thickness of the flange shall be regulated by the maximum and minimum flange thickness gages adopted by the M. C. B. Association.

9. All wheels must be numbered consecutively in accordance with instructions from the railroad company purchasing them, and shall have the number, the normal weight of the wheel, also the day, month and year when made plainly formed on the inside plate in casting, and no two wheels shall have the same number. All wheels shall also have the name of the maker and place of manufacture plainly formed on the outside plate in casting.

10. Individual wheels will not be accepted which

(1) Do not conform to standard design and measurements.
(2) Are under or over weight.
(3) Have physical defects described in Section 2.

Any lot of one hundred wheels submitted to test will not be accepted

(1) If wheels broken do not meet the prescribed drop test.
(2) If the wheel tested does not stand the thermal tests.
(3) If the conditions prescribed in Section 3 are not complied with.

11. All wheels must be taped with M. C. B. standard design of wheel circumference tape having numbers 1, 2, 3, 4, 5 stamped ⅛ in. apart, the figure three to represent the normal diameter, 103.67 in. circumference; the figure one, the smallest diameter, and the figure five, the largest diameter.

The report meets with the full approval of the Wheelmakers' Committee. It is signed by William Garstang, chairman; G. R. Henderson, E. D. Nelson, W. H. Lewis, Alex. Kearney and H. J. Small.

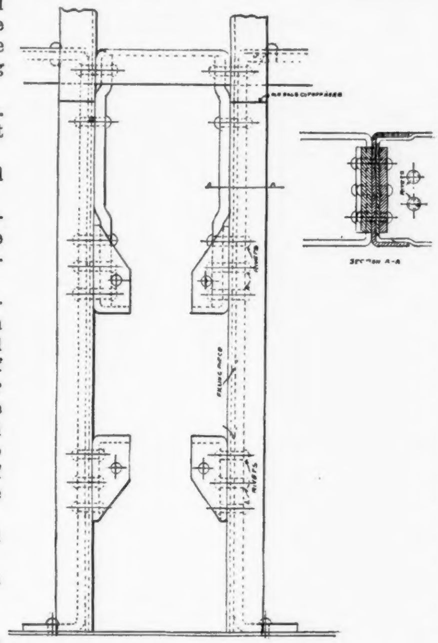
PRICES FOR REPAIRS TO STEEL CARS.

The cost or price of labor used for repairing steel cars should be based on a set price per rivet, including removing, fitting and replacing. Where the parts removed require straightening, this to be done and a separate price paid for the operation.

Basing the cost or price of repairs to steel cars on a fixed price per rivet is the only equitable basis that could be found. If it was attempted to pay for the work on a basis of per piece fitted and applied, every different design of steel cars and cars constructed with steel underframes would have to be taken into consideration, and each part or piece numbered or marked so that the proper price could be fixed for such operation.

The committee recommends that the following price govern the removal and replacing of rivets, such price to include removing, fitting and replacing damaged parts, less straightening or repairing: All rivets, 10 cents per rivet.

Where the parts or pieces removed from a damaged car require straightening or repairing, it is recommended that such straightening be charged for per pound. If this work would be charged for per piece, the different design and construction of steel cars would have to be taken into consideration. It is, therefore, recommended that the following price govern such work: Sixty cents per 100 lbs.



Repairs to Steel Cars.

Where cars are damaged to such extent that the parts damaged do not have to be removed for repairs, but straightened on car, also any parts that require straightening, repairing or renewing, not included on the rivet basis, it is recommended that the present M. C. B. price for labor, covering repairs to wooden cars, namely, 20 cents per hour, govern in all such work.

The painting of steel cars, after receiving repairs, should be governed by the present M. C. B. practice for painting of wooden cars.

The committee would recommend that the splicing of sills on steel cars and cars constructed with steel underframe be permissible, the splice, except as otherwise herein stated, to be located not less than 8 in. from either side of the body bolster and to be not less than 24 in. long, consisting of butt joints. The butt joints to be reinforced by plates on both sides, not less than same thickness of web plate, with the one on the inside of channel to include flangers also, while the outside plate should only cover the web. The rivets to be spaced as may be necessary to obtain efficiency at the point of splicing, but each splice to have not less than 18 rivets.

In cases where cars are damaged to such extent that the center sills have to be cut off less than 8 in. from bolster, in such case a plate, with an angle at each end not less than 6 in., is to be used between end sill and bolster and to be full width of channel and not less than ⅝ in. thick. This to be applied on the outside, between end sill and bolster, between web of channel or I beam, as the case may be, as shown on the drawing.

The committee recommends that where it is necessary to apply any new material to steel cars or cars constructed with steel underframe, that such material, where cars are constructed of structural steel shapes or material that can be purchased in the open market, be charged at market price. Where cars are constructed of pressed steel shapes or material that cannot be purchased in the open market, such material to be charged at manufacturer's price.

Where any material is applied to a steel car, the name of the part renewed and the dimensions of same must be shown on bill.

The committee recommends that scrap material removed from cars constructed of pressed or structural steel shapes be credited at ¾ cent per pound.

Where patching is done on steel cars, the committee would recommend that such patching be done in a mechanical manner. Where floor or interior patches are applied, the outside edges should be chamfered and patch riveted to place with thin flat head rivets.

The committee finds from the answers received that the oldest steel cars have been in service eight years, and as yet no steel cars have been put out of service due to deterioration from age. Nothing definite has been obtained on which to base a report as to the depreciated value of steel cars and cars constructed with steel underframes. The committees would recommend, however, that a depreciation of 4 per cent. upon the yearly depreciated value be used for the bodies of all steel cars and cars constructed with steel underframes, allowing the present 6 per cent. per annum upon the yearly depreciated value of trucks to remain as at present in the rules, but no depreciation should exceed 60 per cent.

In the present rules there is no special provision for the settlement of destroyed steel cars, which are of more expensive construction than the average wooden car of similar capacity, and the committee would recommend that a special committee be appointed to carefully consider the price for all steel cars of various classes, as well as cars constructed with steel underframes. In order to provide for an equitable way of settlement for the coming year, until the committee's report is received, it is recommended that all steel cars or steel underframe cars destroyed be treated on the same settlement arrangement as now in effect for "Special Constructed Cars," as covered by M. C. B. Rule No. 113 of the 1903 code.

The report is signed by T. H. Russum, Chairman; R. F. McKenna, I. N. Kalbaugh, G. N. Dow, E. B. Gilbert.

COUPLING CHAINS.

There are two classes of coupling chains, permanently attached coupling or safety chains and loose chains, usually carried in the caboose for chaining up cars under special conditions.

Permanent Safety Chains.—The majority of the railroads object to the use of any permanent safety chain, for the following reason:

To permit cars to pass freely around curves, there must be considerable slack in such chains when coupled, and the further away from the center of the car these chains have to be located, the greater the amount of slack necessary. When couplers give way, the jerking, due to the slack in these chains, breaks the hooks and links and cracks or pulls off the end sill.

It is not practicable to place these chains

nearer to the center of the car than the position shown on M. C. B. Sheet "A," on account of location of longitudinal sills and dead blocks, and on account of interference with air-brake angle cocks and hose. A permanent safety chain might be placed closer to the center, perhaps attached under the end sills to the longitudinal sills or draft sills and crossed under the coupler, in which case the chain could be hooked up fairly tight, but this would seriously interfere with the coupler and air-brake connections.

If the safety chain is used it should be attached to inside of the end sill by draft springs and followers so as to cushion the jerk, should the couplers part, and save the damage to the end sill. Another way would be to have the chains attached to the longitudinal sills and not secured in any way to the end sills, the purpose of this being to avoid injury to the end sills in case the safety chains are called into use. Of these suggestions, the latter is probably the preferable one.

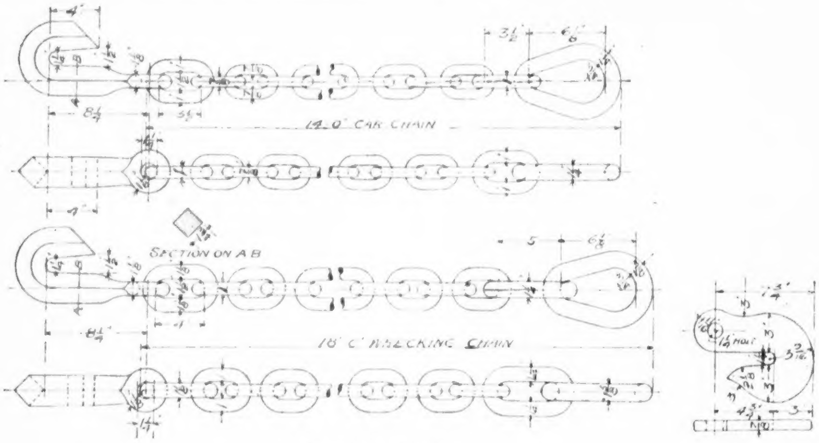
The number of cars equipped with safety chains is small, and these are mostly flat cars or drop-end gondolas, many of them steel cars of modern construction. Some roads have a limited number of refrigerator, stock, horse and special ventilated box cars equipped with safety chains for the purpose of running such cars in passenger trains, and have the safety chains coupled to the regular passenger car safety chains in such service.

The committee recommends that the M. C. B. Sheet "A," recommended practice for end-sill safety chains or coupling chains, should remain as shown, but that the nuts and washers shown on this drawing as securing the chain at the back of the end sill should be omitted from the drawing and notation placed thereon to the effect that such chains should be secured firmly to the longitudinal sills and located as nearly to the distance as shown on Sheet "A" as the location of the longitudinal sills will permit.

Loose Chains.—After tabulating the lengths, links, size of links, dimensions of hooks and other details of chains carried on wrecking cars or in cabooses on a number of roads, the committee prepared a drawing, showing two chains, one 14-ft. chain, with diamond hook, made of ⅞-in. link, common proof chain, which is of the dimensions most generally recommended for chaining cars together, either for double loads or in case of draw-heads being pulled out on the road; and one 18-ft. wrecking chain made of 1-in. standard short-link proof chain, with diamond hook, for general wrecking purposes, and which can also be used for chaining together large-capacity cars in special heavy train service where the 14-ft. chain of ⅞-in. links might not be considered heavy enough.

A flat hook is also shown, which is probably cheaper to make and easier to handle than the diamond hook.

The committee recommends that the Association set a fair value on such chains according to the market price which might prevail from year to year, and when it is desired for such chains to continue over different roads with a double load they could be continued to destination and be billed by the initial road against the road at destination at the M. C. B. cost. In case the chains are returned, same cost figure could be used in counterbilling without reference to the identity of the individual chain, so long as the chains conform to the proposed recommended practice.



Coupling Chains.

The report is signed by R. P. C. Sanderson, Chairman; R. L. Klein, R. B. Rasbridge, Jas. Macbeth.

STANDARD LOCATION OF THIRD RAIL.

The representatives of various railroads about New York City, after much consideration of the subject, have fixed upon a location for third rail, which is very apt to be standard in the electrical construction on steam railroads about New York City, and this location is shown in Fig. 1. Some of the railroads which will be operated electrically have adopted a location for third rail slightly different from the location shown in Fig. 1, but the difference is so slight that the equipment which is constructed to take current from the third rail located as shown in Fig. 1 will operate satisfactorily over construction with the slight variation referred to. Fig. 1, then, can be considered as the most pronounced standard for location of third rail, and one which no doubt will be followed more or less closely by such roads as may take up electrical operation in the future.

The Pennsylvania Railroad and the Long Island Railroad have determined upon certain clearances which will be required for passenger car equipment, freight car equipment and locomotive equipment which will run over their electrical installation, and these clearances are indicated in Fig. 2. Only the clearances prescribed for passenger car equipment and for freight car equipment need be considered, but clearance for locomotive equipment is also shown, in order that the same may be upon record. The New York Central & Hudson River has determined upon certain clearances which will be required for all classes of equipment, and these are shown in Fig. 3. The Pennsylvania, the Long Island and the New York Central installations are shown in Fig. 4, which is a composite clearance diagram.

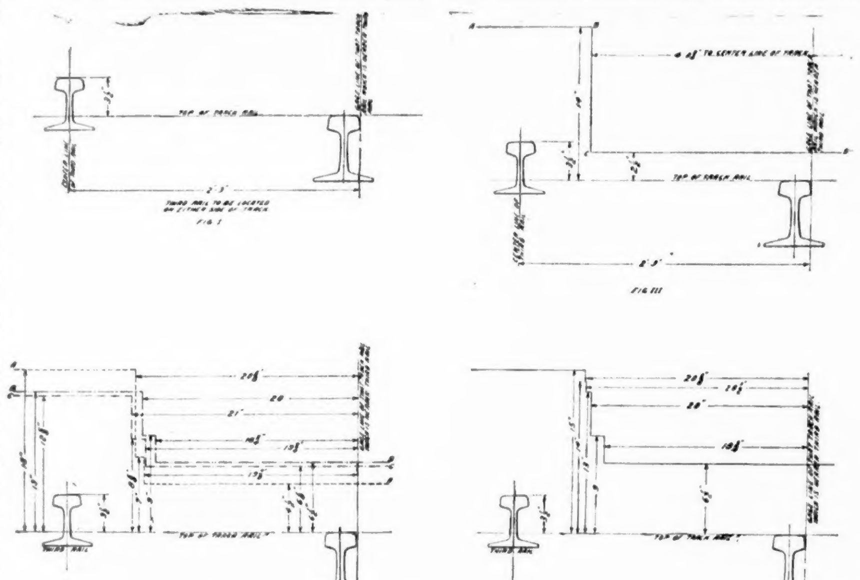
The Master Car Builders' Association cannot adopt any of these clearance diagrams as standard as yet. The most that the labors of this committee could do is to place upon record the clearances of such third rail installations as have so far been determined upon. The report is signed by F. M. Whyte and A. S. Vogt.

WHAT IS THE BEST PREVENTIVE OF RUST ON STEEL CARS?

The committee prepared and submitted to the members a circular embodying 14 questions. The answers to the various questions indicate a wide difference of opinion as to the best methods of overcoming this trouble, and also show a wide variation in the methods of removing rust and scale from steel cars, preparing the metal for painting, and the character and number of coats of paint applied.

In general, the methods pursued in the treatment of steel cars are as follows:

(a) Inside of car—wire brushes, scraping, sand blast and hammering, and in one case,



Location of Third Rail.

after cleaning, the car is blown off with compressed air.

(b) Outside and underneath—wire brushes, scraping and sand blast, and in one instance, gasolene paint burner and scraping.

(c) Character of paint used for first coat, varies from graphite paint, carbon paint, red lead and lampblack and oil, to the various patented paints now on the market. For the second or succeeding coats practically the same character of paint is used, with the exception of a few roads, which use their standard freight car color.

(d) The number of coats of paint applied varies from two to three.

(e) The time between paintings varies from eighteen months to three years. The majority of answers indicate, however, that there is no specified time for painting, it being done whenever the condition of the car requires. One road states that it has discontinued the painting of steel cars, while another road follows up its cars very closely, and whenever rust appears it is removed and the spot repainted.

The general opinion of the roads operating steel cars is that the greatest amount of corrosion is found at the seams and joints, slope sheets and hoppers. The sides also deteriorate very rapidly from abuse, such as loading of hot billets or hot cinders in the cars, and hammering the sides with mauls for the purpose of loosening load. The practice of allowing cars loaded with coal to stand on siding or in storage yard for an undue length of time is found to be detrimental to the cars, as the sulphur water from the coal destroys the sheets very rapidly.

The use of brush and air for applying paint is about equally divided among the different roads, some preferring the brush for the first coat and air for the succeeding coats, while one road uses air at the seams and a brush on flat surfaces.

In consideration of the limited experience in the use of steel cars, and in view of the lack of definite results from experiments which have been made or are being made, the knowledge of this subject is not complete enough to allow of positive recommendations being made as to the best methods of treating steel cars in order to prevent the formation of rust on same. The committee submits the following suggestions:

For new cars—

(a) The steel should be thoroughly cleaned of all rust and furnace scale before the car is assembled.

(b) All joints before assembling should be thoroughly coated with coal tar.

(c) After car is assembled, all grease should be thoroughly removed from the steel, and same given a good coat of carbon or graphite paint on the outside and underneath and the inside a heavy coat of crude petroleum, coal tar applied hot, or some similar substance.

(c) The outside to be given a second coat of graphite or carbon paint, as may be desired.

For old cars—

(a) All scale and rust should be removed wherever it appears on the car, by steel brushes or scrapers; and in the case of the inside of the car by any of the above methods or by the use of pneumatic hammers or mauls.

(b) After all scale and rust have been removed, the car should be thoroughly cleaned with steel scrapers or wire brushes, and blown out with air, in order to present a clean surface for the paint.

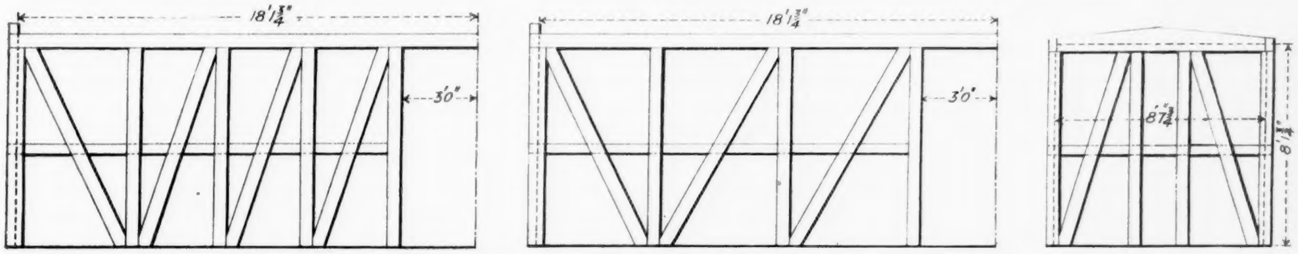
(c) The methods of painting recommended for new cars should be followed out in the case of old cars, after a clean surface is obtained.

As some of the most prolific causes of deterioration of steel cars are the loading them with hot billets, the use of mauls, bars, etc., on the outside to assist in the unloading of cars, and allowing cars loaded with soft coal to stand a long time with the load in them, it is recommended that steps be taken to do away with these practices as much as possible.

If the above recommendations are followed out, and if care is taken to repaint the outside of and underneath cars at least eighteen months or two years, coating the inside with crude petroleum or coal tar about once a year, excellent results will be obtained.

It is an open question as to whether the use of the sand blast is desirable for this class of work, on account of the hardships it imposes upon the men operating same, and also on account of the expense attached to its use, due to the very rapid deterioration of the hose and nozzles.

The report is signed by H. S. Hayward, chairman; J. S. Lentz, W. G. Gorrell, T. H. Russum, C. E. Fuller.



Outside Dimensions of Box Cars.

OUTSIDE DIMENSIONS OF BOX CARS.

The committee was unable to determine what finished sizes of timber should be used in the body framing for box cars but submitted the style of side framing shown in Figs. 1 and 2 for 80,000 and 100,000 lbs. capacity cars, and the style of side framing shown in Fig. 3 for 60,000 lb. capacity cars. The style of end framing shown in Fig. 4 is preferable to other styles, and the committee recommends these styles of framing as indicated.

The committee is not yet in position to make any recommendation as to the sizes and disposition of iron rods.

A plank lining 1¾ in. thick on the inside of the ends of cars, extending from the floor to the under side of the end carline is recommended. It should be understood that this would necessitate lengthening the car 1¾ in., or thereabouts, if such plank lining were adopted, in order to maintain the inside dimensions, 36 ft. long, adopted by the American Railway Association.

The committee considered the location of the center of the body bolster and bolster post with reference to the face of the end sill, and a distance of 5 ft. 2 in. from the center of the bolster and bolster post to the face of the end sill is recommended. The center posts and corner posts of the ends of cars should be reinforced with angle plates and I-beams. The committee also recommends the use of two belt rails in the side and end framing of cars.

The recommendations of this committee made in 1902 are submitted to the convention for adoption as part of this report. They are as follows:

1. That the inside dimensions of box cars as approved by the American Railway Association, namely, 36 ft. long, 8 ft. 6 in. wide and 8 ft. high, be submitted to letter ballot for adoption as standard.

2. For box cars on high trucks (four feet to top of floor):

	Ft.	In.
Height, top of rail to upper edge of eaves.	12	6¾
Width at eaves, at above height, maximum	9	7

be submitted to letter ballot for adoption as standard.

3. For box cars on low trucks (3 ft. 6 in.):

	Ft.	In.
Height, top of rail to upper edge of eaves.	12	0¾
Width at eaves at above height, maximum	9	7

be submitted to letter ballot for adoption as standard.

4. That the words and letters "Standard 12 ft. 6¾ in. by 9 ft. 7 in." be stenciled in 3-in. letters on the end fascia boards on all cars built to these dimensions.

The report is signed by W. P. Appleyard, Chairman; C. A. Schroyer, Jos. Buker, A. S. Vogt, F. H. Clark, H. F. Ball, J. J. Hennessey.

AIR-BRAKE HOSE SPECIFICATIONS.

Rule No. 69 of the Rules of Interchange requires that after July 1, 1904, all air-brake hose applied to foreign cars will be considered as wrong repairs unless they are made in accordance with the M. C. B. specifications and are so labeled. There is nothing in the M. C. B. Rules, however, which requires the owners of a car to apply M. C. B. standard specification hose to their own equipment, therefore, Rule No. 69 will not prevent a great deal of the trouble which is being experienced with burst hose of inferior quality. The committee has recommended to the Arbitration Committee that it be made compulsory on the part of a railroad to use M. C. B. standard specification hose on all equipment which is interchanged, after July 1, 1905.

In order that this rule may be made operative and the M. C. B. standard maintained, the committee recommends that arrangements be made with Purdue University to have M. C. B. specification hose tested there; hose to be removed from equipment as the committee may see fit, to be given the M. C. B. standard tests, after being in service from six months to one year. In this way the committee could obtain some valuable data on the life of air-brake hose from which to make up standard specifications in the future.

The original specifications for air-brake hose provided for a woven hose with seamless tubing. The present specifications do not cover this feature. It is advisable to

allow this form of air-brake hose to be used if it will meet the tests.

A number of roads have kept service records to determine the life of hose made by the different manufacturers. Two of the most notable points brought out in these records are, the rapid falling off in the friction between the layers of duck after a comparatively short life, and damage at the nipple end of the hose, due to separating cars without uncoupling the hose by hand. Nearly all of the hose tested stand the bursting pressure satisfactorily after being in service for some length of time, showing that the present bursting test, calling for 500 lbs. pressure for 10 minutes is higher than necessary. This service record, to a large extent, should determine whether the present specifications are correct. The records show that it is not always the M. C. B. specification hose that gives the longest life. At least 80 per cent. of air-brake hose fail on account of unfair usage, for which the manufacturer is not responsible. The committee has recommended a specification which should give as long life as the present M. C. B. standard. It can be made for at least 7 cents per foot less than the present M. C. B. standard, and the saving to the railroads should be very large.

The life of an air-brake hose is governed largely by the treatment it receives in service. The most destructive practice is pulling cars apart without uncoupling hose by hand, for which the responsibility in some cases lies with the Motive Power Department and in other cases with the Transportation Department. If the hose in large terminal yards were cut by the inspectors, this damage would be largely decreased. If the responsibility is divided between the yard men and inspectors, there is no way of stopping the abuse on account of the responsibility being divided. The committee recommends that the responsibility for parting air-brake hose by hand be placed entirely on the Motive Power Department in terminal yards, and that united action be taken by all railroads to put a stop to the present abuse.

The improper location of train pipe and angle cock is fully as bad as pulling the cars apart without uncoupling hose by hand. The standard 22 in. hose is of sufficient length if the angle cock and train pipe are located as per M. C. B. recommended practice. If, however, the train pipe is located over 13 in. away from center line of car and the angle cock is vertical, the distance is greatly increased, and when the slack is taken out of the couplers the hose is ruptured. This is a condition which should receive immediate attention.

On account of excessive damage to hose at the nipple end, the committee has increased the inside diameter ⅛ in. This will not increase the cost of manufacture above hose manufactured with enlarged ends, and will give a little larger diameter at the nipple end where it is greatly needed.

Particular attention is called to the damage done to the inner tube by improper mounting of hose. Air machines for mounting hose, if not properly made, do great damage to the inner tube. It is also very important that the hose be so applied to cars that the heads will register properly when they are coupled. If it is necessary to twist them in order to couple, the danger from burst hose is greatly increased on account of the liability of hose bursting when the slack is taken up on the train.

Specifications and test for air-brake hose are herewith modified as follows:

(1.) All air-brake hose must be soft and pliable and not less than two ply nor more than four ply. They must be made of rubber and cotton fabric, each of the best of its kind made for the purpose; no rubber substitutes or short-fiber cotton to be used.

(2.) The tube must be hand-made, composed of three calendars of rubber. It must be free from holes and imperfections, and in joining, must be so firmly united to the cotton fabric that it cannot be separated without breaking or splitting the tube. The tube must be of such composition and so cured as to successfully meet the requirements of the stretching test given below. The tube to be not less than $^3/_{32}$ in. thick at any point.

(3.) The canvas or woven fabric used as wrapping for the hose to be made of long-fiber cotton, loosely woven, and to be from 38 to 40 in. wide, and to weigh not less than 20 and 22 ounces per yard, respectively. The wrapping must be frictioned on both sides, and must have, in addition, a distinct coating or layer of gum between each ply of wrapping. The canvas wrapping must be applied on the bias. Woven or braided covering should be so loose in texture that the rubber on either side will be firmly united.

(4.) The cover must be of the same quality of gum as the tube, and must not be less than $^1/_{16}$ in. thick.

(5.) Hose is to be furnished in 22-in. lengths. Variations exceeding ¼ in. in length will not be permitted. Rubber caps not less than $^1/_{16}$ in. nor more than ⅛ in. must be vulcanized on each end.

The inside diameter must not be less than 1⅜ in. nor more than $1^7/_{16}$ in., nor must the outside diameter exceed 2 in. Hose must be smooth and regular in size throughout its entire length, except at a point 2½ in. from either end where the inside calendar of rubber may be increased $^1/_{16}$ in. for a distance of ¼ in. toward either end and then tapering to the regular diameter.

(7.) Each length of hose must have vulcanized to it a badge of white or red rubber as shown. On the top of the badge the name of the purchaser; on the bottom the maker's name; on the left-hand end the month and the year of manufacture, and on the right-hand end the serial number and the letters "M. C. B. Sta." The letters and figures must be clear and distinct, not less than $^3/_{16}$ in. in height, and stand in relief not less than $^1/_{32}$ in. so that they can be removed by cutting without endangering the cover. Each lot of 200 or less must bear the manufacturer's serial number, commencing at one (1) on the first of the year and continuing consecutively until the end of the year.

For each lot of 200, one extra hose must be furnished free of cost.

(8.) Test hose will be subject to the following tests:

Bursting Test.—The hose selected for test will have a section 5 in. long cut from one end and the remaining 17 in. will then be subjected to a hydraulic pressure of 100 lbs. per sq. in., under which pressure it must not expand more than ¼ in. nor develop any small leaks or defects. The section will then be subjected to a hydraulic pressure of 400 lbs. per sq. in. for ten minutes, without bursting.

Friction Test.—A section 1 in. long will be taken from the 5 in. piece previously cut off, and the quality of the friction determined by suspending a 20-lb. weight to the separated end, the force being applied radially, and the time of unwinding must not exceed 8 in. in ten minutes.

Stretching Test.—Another section 1 in. long will be cut from the balance of the 5 in. piece, and the rubber tube or lining will be separated from the ply and cut at the lap. Marks 2 in. apart will be placed on this section, and then the section will be quickly stretched until the marks are 8 in. apart and immediately released. The section will then be remarked as at first and stretched to 8 in. and will remain so stretched 10 minutes. It will then be released, and 10 minutes later the distance between the marks last applied will be measured. In no case must the test piece break or show a permanent elongation of more than ¼ in. between the marks last applied. Small strips taken from the cover or friction will be subjected to the same tests.

(9.) If the test hose fails to meet the required tests, the lot from which it was taken may be rejected without further examination, and returned to the manufacturer, who shall pay the freight charges in both directions. If the test hose is satisfactory, the entire lot will be examined, and those complying with the specifications will be accepted.

The report is signed by LeGrand Parish, Chairman; T. S. Lloyd, J. Milliken, F. H. Scheffer, H. Swoyer.

DRAFT GEAR.

The committee is still unable to make definite recommendations or to design a standard draft gear. The recommended practice as shown on M. C. B. Plate B for attachment of automatic couplers to cars, should be withdrawn as not being of sufficient capacity for modern cars. Something should be done

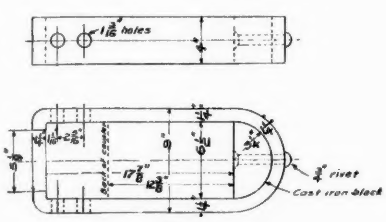


Fig. 1.

to restrain the rapid increase in the number of designs, which vary but slightly in detail. If limiting dimensions could be adopted within which the designers might work, the benefits derived would be considerable. The majority of cars recently built use either friction, tandem or twin spring devices.

Spacing for Center Sills.—The committee recommends that the spacing between cen-

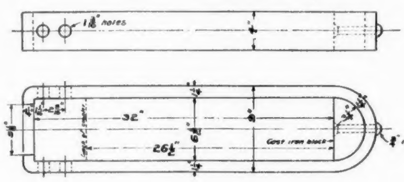


Fig. 2.

ter sills should be 10 in. for cars with wooden sills, and 12⅞ in. for cars with metal sills.

Distance from Horn of Coupler to Face of Buffer Beam.—The committee recommends the distance from horn of coupler to face of buffer beam to be: 1¾ in. for twin spring; 1¾ in. for tandem spring; 2¾ in. for friction type.

Distance Between Stops.—The committee

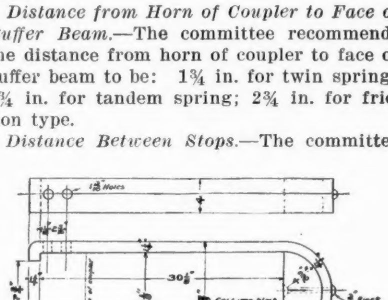


Fig. 3.

recommends that the distance between the front and back stops should be: 12⅜ in. for twin spring; 26½ in. for tandem spring; 24⅝ in. for friction type.

Followers.—The committee recommends that followers 1⅝ in. thick be used with the tandem spring, and 2¼ in. thick be used with the twin spring and friction type.

Yoke.—The committee recommends the design of yoke as shown in Fig. 1 for twin spring, Fig. 2 for tandem spring, and Fig. 3 for friction type.

The committee calls attention to the necessity of using on all wooden construction some form of check plate, in which the front and back stops are united in one piece, this plate to be L or T shape, so that bolts may pass vertically through the center and draft sills, as well as horizontally through the center or draft sills. Many cars are still being built or perpetuated in which short timbers are being used, secured to the car by a few bolts only. Where the draft timber does not go through the body bolster, heavy rods should be used, with front ends secured to draft gear, passing through body bolster and the tie timber to which they are secured. Anchor blocks should also be used between the sills and the draft timbers, and filling blocks should be used back of the body bolsters to give continuous resistance to draft timbers. The committee recommends that "continuous draft rigging" be abandoned as speedily as possible.

The report is signed by E. D. Bronner, Chairman; T. A. Lawes, Le Grand Parish.

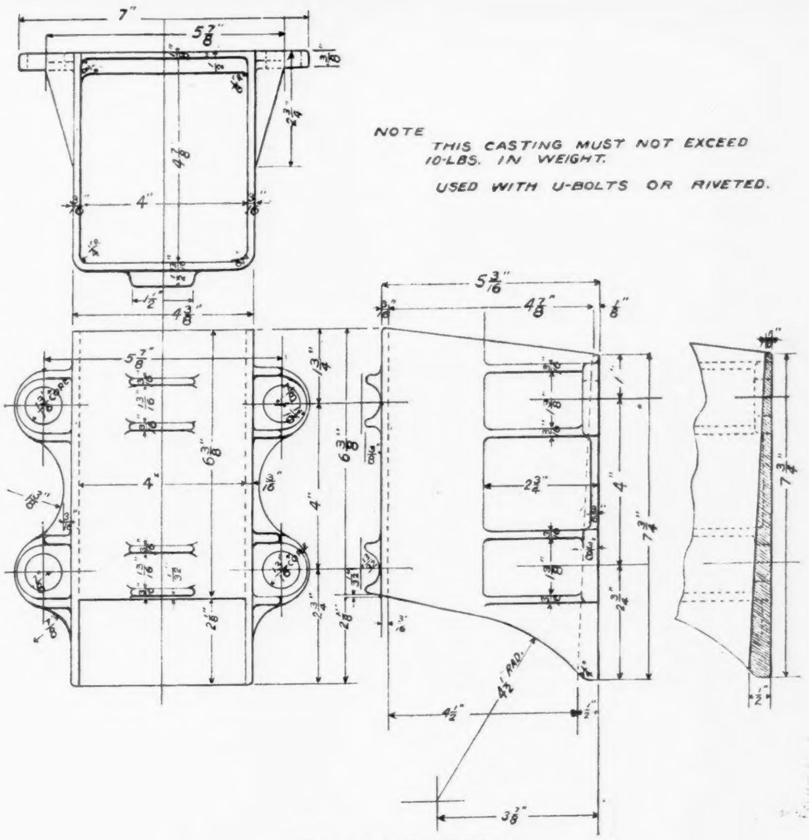


Fig. 2—Stake Pockets.

STAKE POCKETS.

While a majority of the roads are not in favor of the tapering wedge in back of pockets, the committee thinks it is due to a misunderstanding of the results that can be obtained, due to not having had any experience with this form of construction.

The committee recommends the wedge in back of pocket next to sill as shown in Fig. 1 for the following reasons:

It adds additional strength to the pocket and the rest of the pocket can be made much lighter. It is necessary to taper pocket only in one place, viz.: at the back, which is the wedge. This makes it necessary to dress the stake tapering only on the outside on account of the pocket being straight on the remaining three sides. When fitted to a car equipped with this design of pocket, and the car is empty, stakes 6 ft. high will be 6 in. closer at top than at bottom, before car is loaded, or before stakes have been wired or cleated. This shows that stakes fitted to a tapering back, stake pocket would have to move out 3 in. at top before stakes will be straight, which would be ample to take up slack due to loose "U" bolts or side sills or careless wiring or cleating. A car with stakes fitted to stake pockets without wedge in back would be straight before car is loaded or stakes wired or cleated, and stakes would necessarily spread when loaded. Practical experience shows that loads have to be adjusted very much less with the design of stake pocket with wedge in back. If, for any reason, it would be advisable to have stakes stand straight at the start, all that need be done is to reverse stakes. Stakes can be fitted much better against metal than wood. The wedge also prevents damage to sills of wooden cars.

Only one objection could be raised against the use of the wedge in back of pocket. The stake would not have as long a leverage with this form of pocket, from the fact that the stake projecting through the pocket would not come in contact with the sill of car, which would have a tendency to throw more strain on the top U-bolt. It is the experience of many roads that stakes are seldom so neatly fitted that the stakes will come in contact with the sill of the car at the bottom so as to get the advantage of this leverage. In designing the pockets shown in Figs. 1 and 2, the wedge at the bottom has been dropped as low as practical to meet this objection. This one objection is more than offset by the many points in favor of construction of stake pockets with tapering-wedge pocket.

A majority of the roads favor stake pocket being held by rivets on steel cars, but the committee strongly recommends the use of U-bolts, even with steel construction, for the following reasons:

It makes a stronger design to have stake pockets on steel construction held by U-bolts. If desired, in construction or repairs, U-bolts can be riveted on the inside. Where

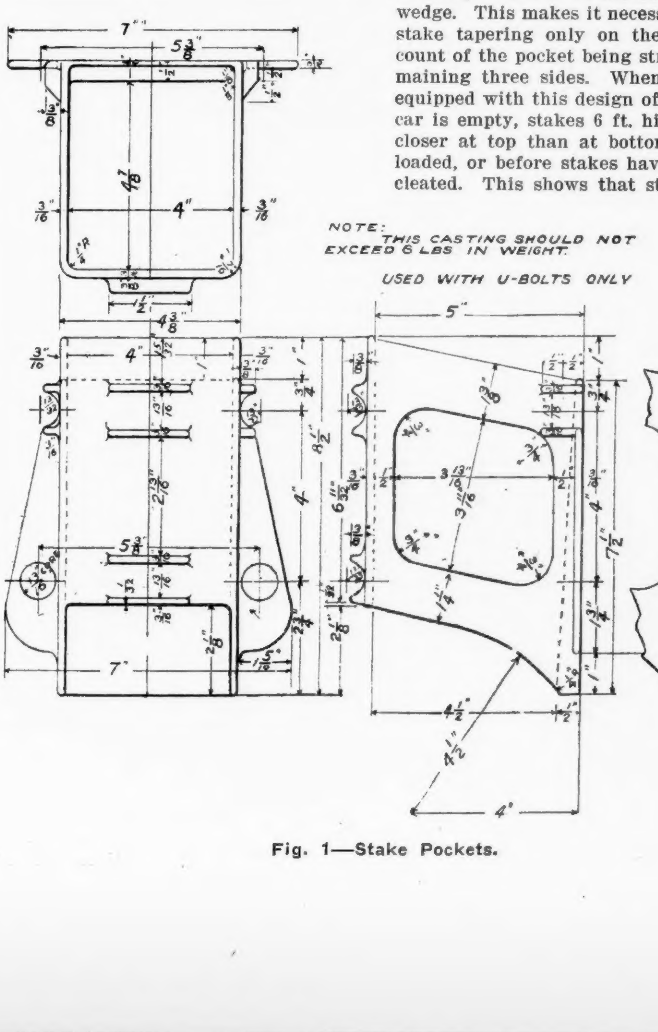


Fig. 1—Stake Pockets.

pockets are riveted, all the strain is thrown on flange of pocket and it would require a pocket of much stronger design. If stake pockets are held by rivets, it will require two different standards of stake pockets, as spacing for U-bolts will have to be different in order to give room for rivets to be driven or for the heads of the rivets.

In order to get the matter before the Association in proper shape, the committee has designed a stake pocket for steel cars to be held on by rivets, shown in Fig. 2. This will not interchange with pocket shown in Fig. 1.

A number of roads apply stake pockets to side sill of cars, and temporary stake pockets or strap to side of the car. This is good practice, and this class of cars should be equipped in that manner.

The committee would, however, recommend that the temporary stake pocket or strap be 4¼ by 5¼ in. inside dimensions, so as to receive standard stakes; and that dimensions for this temporary stake pocket or strap be not less than ½ by 2½ in.; held by bolts or rivets.

The conclusions and recommendations of the committee summarized are:

First.—That a standard stake pocket be adopted.

Second.—That inside dimensions of same be 4 in. wide, 5 in. deep.

Third.—That a tapering wedge be used, as shown in Figs. 1 and 2.

Fourth.—That the method of securing stake pockets to both wooden and steel construction be by U-bolts, held by nuts or riveted.

Fifth.—That malleable iron be used as standard construction.

Sixth.—On a 40-ft. car that *not less* than 10 pockets be applied, in the following manner. Measuring from center of car, pockets to be applied equal distances from each side of center.

On a 35-ft. car, *not less* than nine pockets to be applied; first pocket in center of car and balance of pockets spaced equal distances apart.

On 32-ft. cars, *not less* than eight pockets; measuring from center of car, pockets to be spaced equal distances from center of car.

If any roads desire that pockets be placed closer at ends of car and wider apart at center, this can be done.

The report is signed by J. S. Chambers, Chairman; W. E. Fowler, J. E. Keegan, R. P. C. Sanderson, M. Dunn.

STEEL IN PASSENGER CAR CONSTRUCTION.*

A study of the comparative efficiency of wood and steel for a structure like a 70-ft. passenger car may be made by reference to the diagrams, Figs. 1 and 2, showing the usual construction in wood, and a proposed section for a steel passenger car frame. It is often claimed that for equal weight wood is as strong as iron or steel, and for ordinary rectangular beams this may be true, but it is not correct when steel is disposed in the shape of a deep plate girder with a thin web and heavy flanges. In this way a large moment of inertia and a high moment of resistance is obtained per unit of weight, which cannot be secured in wood, as there is not room enough in the space available in car construction for the volume of wood required. To illustrate this we may take the section of the side of a wooden car below window sills as equivalent to a solid beam 4 in. thick by 28 in. deep, and the weight of Norway pine as 40 lbs. per cu. ft. The weight of steel being 480 lbs. per cu. ft., the ratio of weight of pine to steel is 1 to 12. The ultimate strength of pine may be taken as 4,000 lbs. per sq. in., and of low carbon steel 50,000 lbs., the ratio being about the same. The strength of the sections will be proportional to their moments of resistance. Now—

$M = fs.$

f = safe unit load = 1,200 lbs. for Norway pine.

S = section modulus.

$$S = \frac{bh^2}{6} = \frac{4 \times 28^2}{6} = 523, \text{ for wood beam.}$$

$M = 1{,}200 \times 523 = 627{,}600$ in. lbs.

For the steel section (Fig. 3) taking 16,000 lbs. per sq. in. as outside fiber stress in tension at lower flange and 10,000 lbs. unit stress in upper flange, the moment of resistance is found as follows:

(For calculation of moment of inertia of the steel girder see appendix.)

Section modulus top flange $S_c = 162$.

" " bottom flange $S_t = 170$.

$\therefore M_c = 162 \times 10{,}000 = 1{,}620{,}000$ in. lbs. and $M_t = 170 \times 16{,}000 = 2{,}720{,}000$ in. lbs.

The top flange being the weaker, its value of M will govern and

$$\frac{1{,}620{,}000}{627{,}600} = 2.58$$

Fig. 3.

This particular steel girder is about 2.6 times as strong as the assumed wooden one. The wood section 1 ft. long weighs 31 lbs., and the steel section 52 lbs. The comparative strength for equal weight is therefore 1 to 1.55 in favor of steel.

Mr. George I. King, General Manager and Vice-President of the Middletown Car Works,

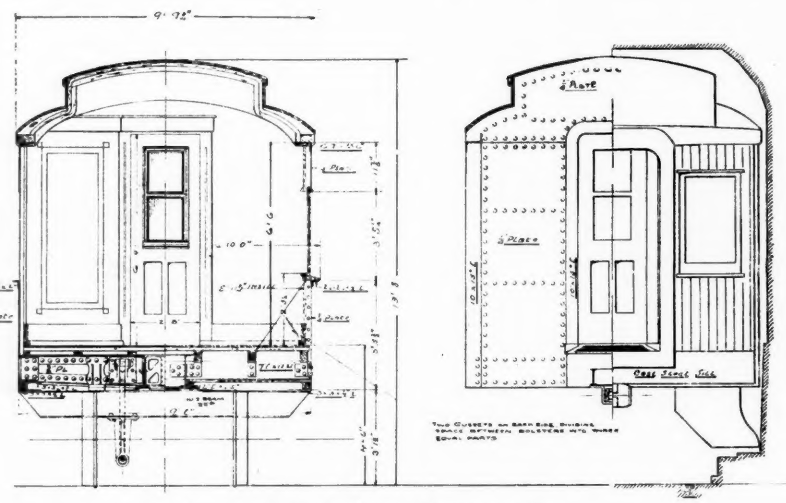


Fig. 4a—Steel Underframe Passenger Car.

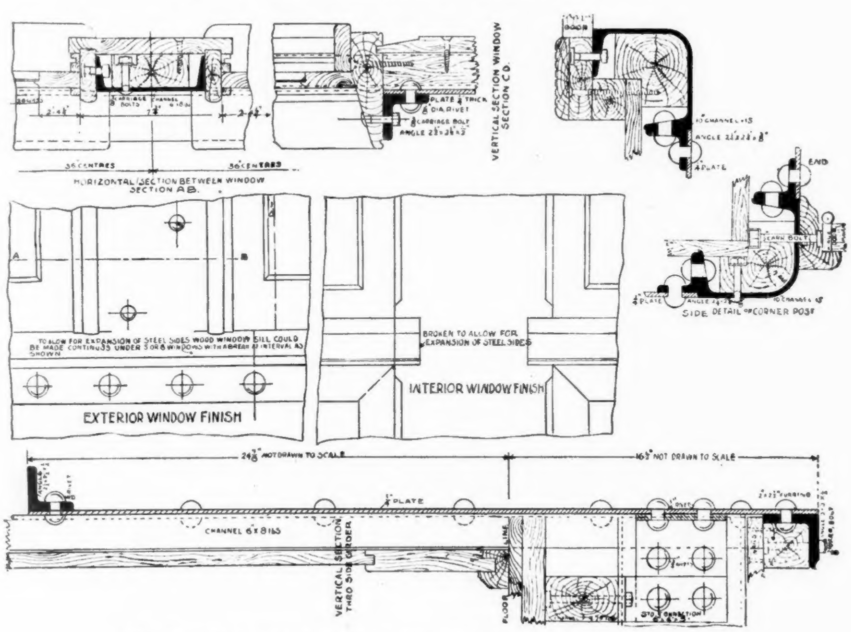
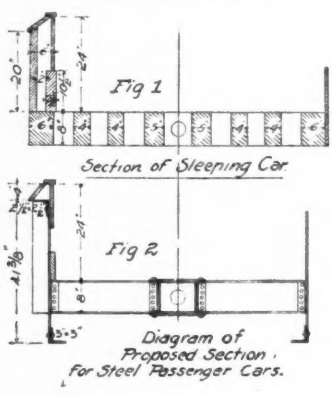


Fig. 5—Plate Girder, Side Sill and Channel Iron Posts.

*Extracts from an individual paper by William Forsyth, read at the Master Car Builders' Association Convention, Saratoga, June 23, 1904.



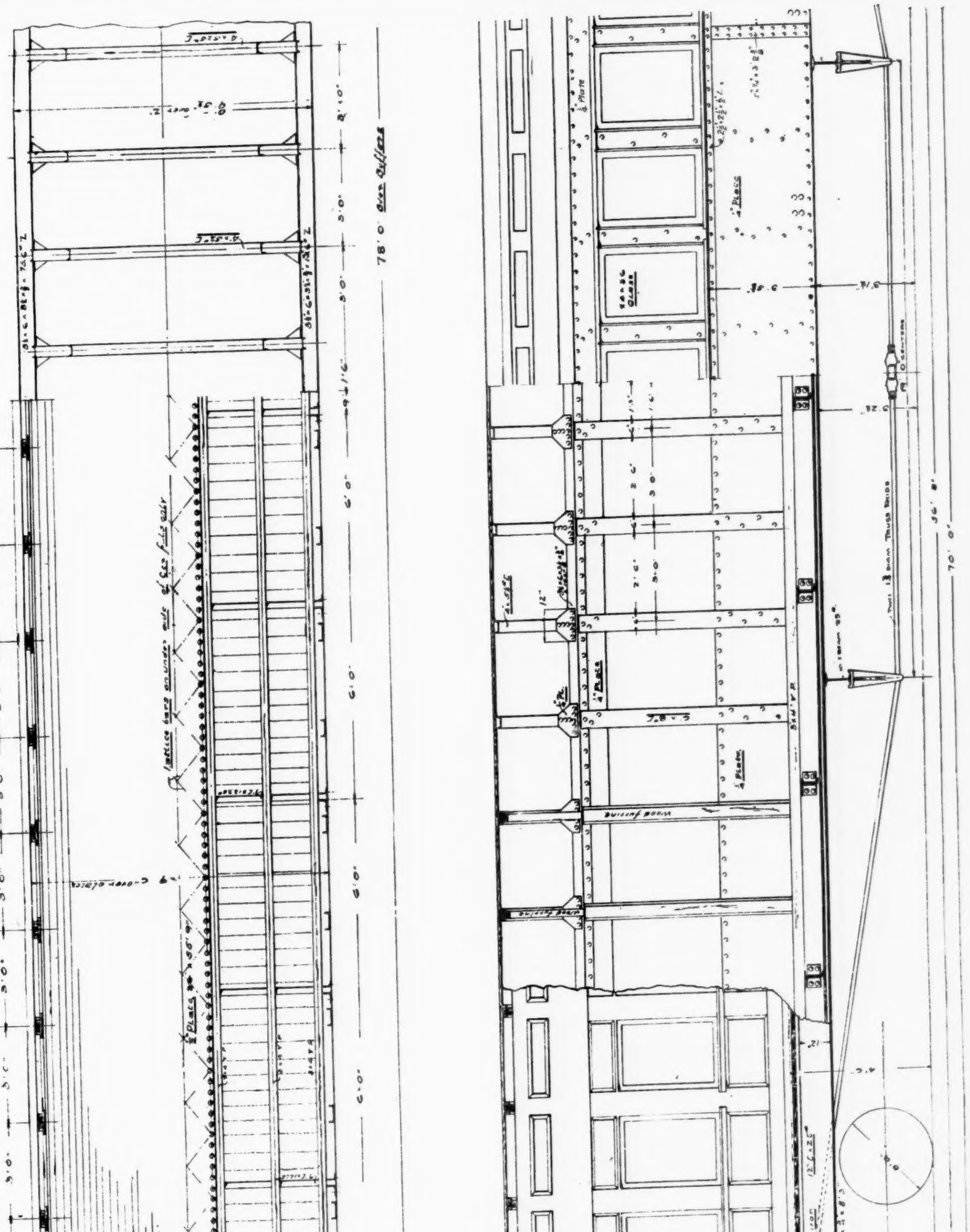


Fig. 4—Passenger Car With Steel Underframe.

Middletown, Pa., has designed a steel passenger car shown in general plan in Fig. 4 and 4a and details in Figs. 5, 6, 7, and 8. The side of the car below the windows is formed of a deep steel girder made of 1/4-in. plate, 41 3/8 in. deep with 2 1/2 x 2 1/2 x 1/2-in. angles at the top and 3 x 3 in. x 1/2-in. at the bottom. The center sills are made of 12-in. channels, 25 lbs. per ft., with lattice bracing and flange plates 6 in. x 1 in. on the bottom and 1/2-in. and a stiff side plate connecting them at the top, the whole construction being tightly bound together. It is probable that the first cost and the weight of a car of this design will be somewhat greater than the regular wooden coach, but from the experience gained in building such cars it is believed that with a steel car of somewhat similar construction, having the advantage of pressed steel forms wherever possible, and culations relating to the strength and stiffness of this steel coach frame are given in the appendix.

Steel underframes for sleeping and dining cars, 65 1/2 ft. long, have been built in England by the London & North Western Railway for the fast trains on the east coast route between London and Edinburgh. In these cars the center sills are of 9 1/4 by 3/8-in. channels, and the side sills 10 by 5/8-in.

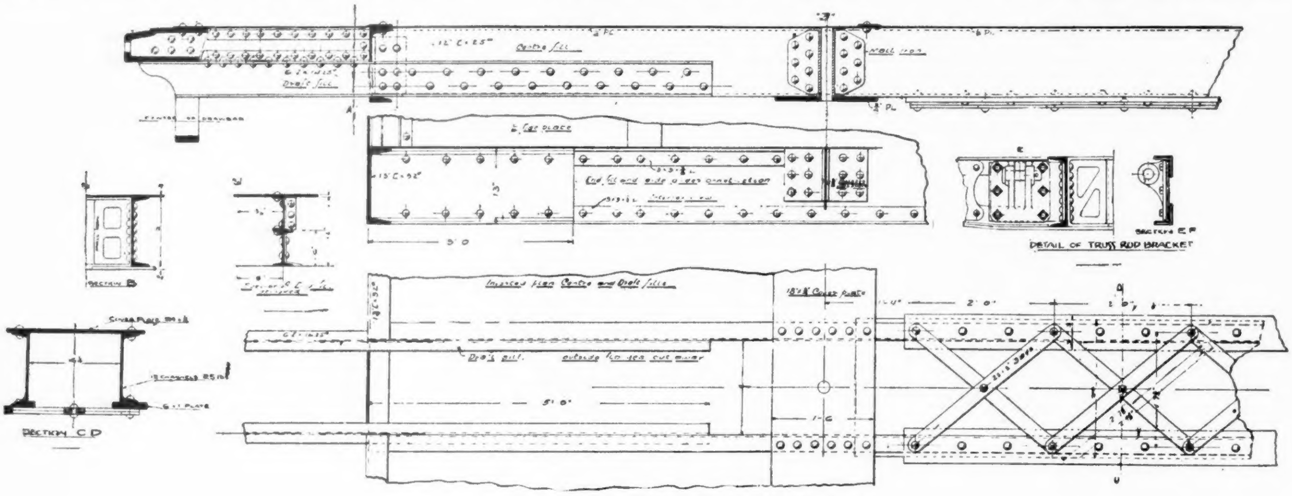


Fig. 6—Center Sills and Draft Timbers.

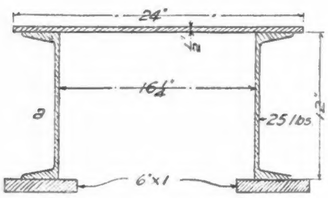


Fig. 9—Section a.

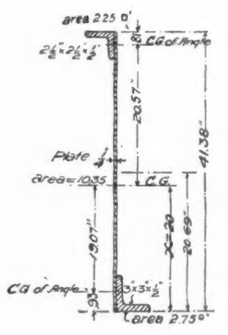


Fig. 12.

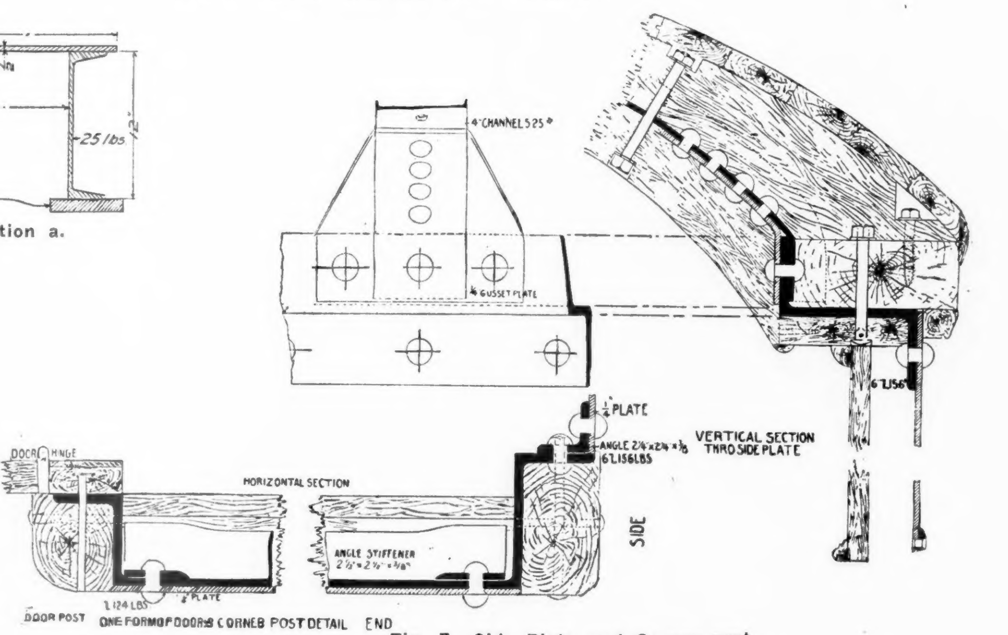


Fig. 7—Side Plate and Corner post.

plates 24 in. wide on top. The posts between the windows are made of 6-in. channels which extend from floor to roof. The longitudinal plates are 6-in. Z bars 15.6 lbs. per ft., and steel carlines connect these for the upper deck. The whole outside and ends of the car, except the windows and doors, are made of 1/4 in. steel plates with rivet heads plainly showing. The center sills and side sills are connected by 7-in. channels 12 1/4 lbs. per ft., and the body bolsters are quite similar to those used in steel freight car construction. The end corner posts and the end door posts are formed of 10-in. channels, 15 lbs. per ft., bent to a quarter circle. Some of these features, in connection with the Z-bar plates and the end posts, have been patented by Mr. King. The whole side of the car is a compound steel girder made up of the deep plate girder below the windows, with numerous posts riveted to it, such improvements as are always developed in actual construction, a cheaper and lighter car can be built by the use of steel which will be stronger in resisting the force of collision and practically fireproof. The steel passenger car will thus be developed by experience in construction, by a display of ingenuity in designing efficient details, and the adaptation of fireproof materials to a simpler inside finish.

All the large timbers are removed and the floor can be made entirely fireproof. The quantity of wood in the car body is very much reduced and the small sections could easily be made fireproof. It is desirable to have wood or an equivalent non-conductor on the inside of a steel car of this or almost any other construction, not only for inside finish but as a non-conductor in order to make the interior comfortable in hot or cold weather and to prevent noise. The cal- channels. There are four truss rods, the outside one being 1 1/2 in. in diameter, and the center ones are 1 1/4 in. in diameter. They are braced diagonally and the drawbars are continuous. In order to prevent noise and to make the car less rigid, the sills are covered with a thin strip of pine and on this a continuous line of rubber is laid, and the car body is bolted to the sills. The car body weighs 58,000 lbs., two trucks 32,000 lbs., total 90,000 lbs. A model of this car is now on exhibition at the St. Louis Exposition.

The majority of the large cars for long distance electric lines are now built with steel underframes. The new cars for the Rapid Transit Company of New York are built almost entirely of steel. These cars are 51 ft. 2 in. over platform sills, and they are 8 ft. 7 in. wide over sheathing. The cars have a capacity for 54 passengers. The

Illinois Central has designed and built at its own shops quite a number of large steel suburban cars, having 100 seats. These cars are 64 ft. long over end sills and 10 ft. 4 in. wide. The underframe consists of four 9-in., 21-lb. steel I-beams, spaced nearly equal distances apart. The end sills are 9-in., 25-lb. steel channels, set with the backs to the square ends of the longitudinal sills and riveted to them by double angle plates reinforced by plate gussets. A steel floor ¼ in. thick is riveted to the sills, forming a continuous metal surface, extending the whole width and length of the car, thus insuring

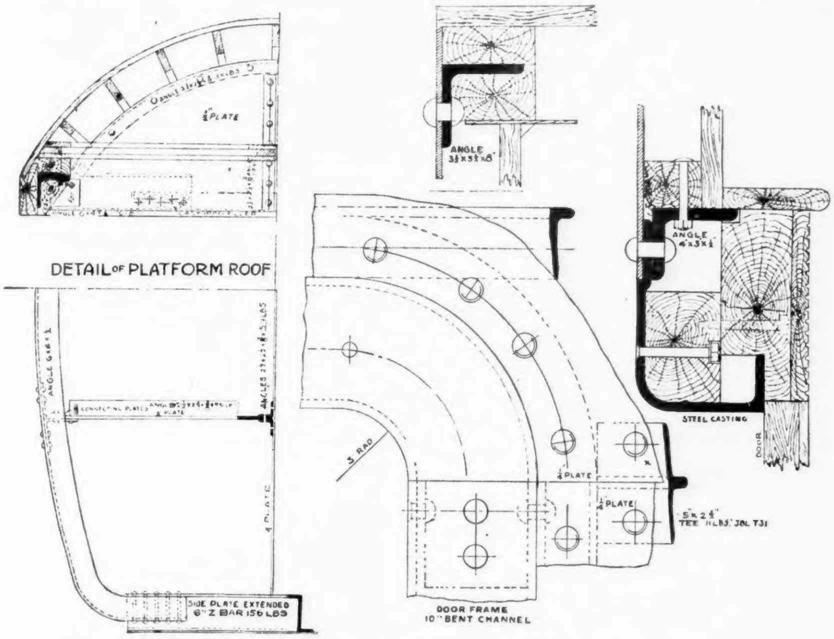


Fig. 8—Platform Roof and Door Post.

perfect rigidity of the underframe and completely protecting the car from fire underneath. The side posts are made of 3-in., 4-lb. steel channels, and the side plate is 4½ x ½-in. iron. The car body weighs 61,400 lbs., trucks 23,200 lbs., total 84,600 lbs. These steel cars have been in service more than a year, and one of them is on exhibition at the St. Louis Fair.

Many car builders prefer to think that

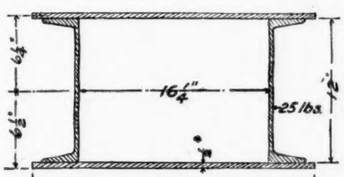


Fig. 10—Section b.

wood construction is good enough for passenger cars, but the use of steel for this purpose is gradually growing, and the conditions of our passenger service seem to indicate that before long it will be forced upon us. When the Interborough Company, of New York City, decided to use steel cars they found it impossible to interest any of the large car builders of this country, and the sample car was designed and built by the Pennsylvania Railroad as an accommodation. Even after the car was built many were skeptical as to its success in service, but the tests of the car have been so satisfactory that the Interborough Company has given the order for the construction of 200 steel passenger cars, and this is really the beginning of this industry in the United States. The Pressed Steel Car Company has been for some time working on plans for steel passenger cars, and this is really the make contracts for the steel frames of such equipment.

The subject is of sufficient importance to demand further treatment, and should be included in the list of subjects for committee investigation for the coming year.

Appendix.—The maximum load of passengers which a coach is required to support does not exceed four or five tons, which is so small as compared with the dead weight of the construction that it might be neglected altogether in figuring the members of the frame. There is a very considerable difference in this respect between a passenger car and a freight car in that in the latter designs the structure must carry a weight several times that of the car, with the result that something like an approximation can be made as to the sections needed to support this weight, making such a liberal allowance for shocks and vibrations as the result of experience and some experimental work may make desirable. On the other hand, to assume anything like a normal vertical load in designing a passenger car might result in sections that would be

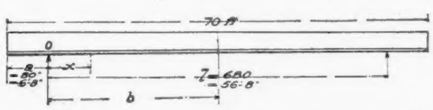


Fig. 11.

insignificant, and to assume a load of, say, 25 tons to be evenly distributed would necessitate more material than normal operating conditions should warrant. The ability of the steel frame to support its vertical load would equally apply as to its strength to resist buffing shocks. Unfortunately, with such a complex frame as shown in our proposed plan, it is practically impossible to say what path the maximum stresses would traverse from end to end of the car, or what these stresses would amount to. We have therefore assumed certain sections as desirable, have to a great extent ignored their *ultimate strength* and have based final judgment as to their fitness, upon the matter of deflection, which in a long span becomes a serious matter.

The following calculations, based on the sections as shown in the plan, have been made by Mr. King to show the safe load the steel frame would carry, and he has derived a formula which is used to determine the deflection of the side and center girders under the safe loads as obtained by these calculations. These figures are given to illustrate a method of arriving at necessary sections in steel car construction where the spans and loading are different from those used for freight cars. They are not intended as an exact and complete solution of the problems connected with the design for a 70-ft. steel coach, but are sufficient to show the necessity of using truss rods for such long spans if excessive weight is to be avoided.

Center sills as shown on drawing, section a, is very similar to section b.

Either section would give practically the same result as to stiffness and strength, and since it simplifies the calculation to ignore the slight eccentricity as to center of gravity in (a), we shall base our figures on (b).

I of one channel = 144.

I of whole section = 2 (144) + 2 (12) 39.

I = 288 + 936 = 1,224.

$$\frac{I}{v} = S = \frac{1{,}224}{6.5} = 188.$$

Now $M = f S$.

Assume $f = 10{,}000$ lbs. per sq. in. for compression side, which should allow ample margin for draft and shocks, since center sills, unlike top flange of side girder, are well supported sidewise (and vertically to some extent) by crossbearers and floor with deafening.

M = 10,000 (188) = 1,880,000 in. lbs. = safe moment at center.

Since $\frac{I}{y}$ for both tension and compression are the same (the neutral axes being at the center of the section) the above moment will cause an outside fiber stress of 10,000 lbs. per sq. in. at the center of car in both tension and compression flanges.

However, before determining from the above moment the safe load with these stresses, let us figure the deflection under a load of 180 lbs. per ft. or a total load of 12,600 lbs. for the center girder.

To derive deflection formula, beam thus:

Make origin at O.

Formula for M at any point x between supports $= \frac{P}{2}(xl - x^2 - a^2)$

$$\text{Slope } i = \frac{1}{EI}\int M dx$$

$$\text{Deflection } v = \int i dx.$$

$$\text{(a) } i = \frac{P}{2EI}\int (xl dx - x^2 dx - a^2 dx).$$

$$= \frac{P}{2EI}\left(\frac{x^2 l}{2} - \frac{x^3}{3} - a^2 x\right) + C$$

$$\text{Now } i = O \text{ when } x = \frac{l}{2}$$

$$\text{Therefore, } C = -\frac{P}{2EI}\left(\frac{l^3}{8} - \frac{l^3}{24} - \frac{a^2 l}{2}\right)$$

Substituting this value below, we have

$$\text{(b) } v = \int i dx.$$

$$= \frac{P}{2EI}\int\left(\frac{x^2 l}{2} - \frac{x^3}{3} - a^2 x - \frac{l^3}{8} + \frac{l^3}{24} + \frac{a^2 l}{2}\right) dx.$$

$$= \frac{P}{2EI}\left(\frac{x^3 l}{6} - \frac{x^4}{12} - \frac{a^2 x^2}{2} - \frac{l^3 x}{8} + \frac{l^3 x}{24} + \right.$$

$\frac{a^2lx}{2} + C_1\Big)$

Now $v = O$ when $x = o \therefore C_1 = O$.

but v is *max.* where $\frac{l}{2} = x$.

$$\therefore v = \frac{P}{2EI}\left(\frac{l^4}{48} - \frac{l^4}{192} - \frac{a^2l^2}{8} - \frac{l^4}{24} + \frac{a^2l^2}{4}\right)$$

$$= \frac{P}{2EI}\left[\frac{a^2l^2}{8} - \frac{5l^4}{192}\right]$$

Therefore, $v = \frac{Pl^2}{384EI}\left(24a^2 - 5l^2\right)$ = deflection at center.

Using this to determine deflection of center sills we have by substitution:

P = 15 lbs. per in., or 180 lbs. per ft.

$$V = \frac{15 \times 680 \times 680}{384 \times 30{,}000{,}000 \times 1224}\left(24\left[6{,}400\right] - 5\left[680\right]^2\right)$$

= 1.06 in. deflection, say 1 in. approximately.

This deflection would not be very apparent in a length of almost 57 ft., nevertheless it is objectionable from some points of view, and it is therefore desirable to use truss rods in order to reduce deflection of center sills.

(e) Side girders.

To find the center of gravity of whole section.

$x\,(2.25 + 10.35 + 2.75) = 2.75\,(.93) + 10.35\,(20.69) + 2.25\,(40.57)\ 15.35x = 2.56 + 214.14 + 91.28 = 307.98.$

$x = 20$ in.

(f) To find moment of inertia of whole section about its center gravity.

Moment plate about *its* C. G. $= \frac{1}{12}\,bl^3 \therefore$
$I_c = \frac{1}{12} \times \frac{1}{4} \times 41.38^3 = 1478$ = moment of plate.

I_c Top angle ($2\frac{1}{2}$ x $2\frac{1}{2}$ x $\frac{1}{2}$) = 1.23.

I_c Bottom angle (3 x 3 x $\frac{1}{2}$) = 2.22.

Final $I_o = 1478 + 1.2 + 2.2 + (10.35 \times .48) + (2.25 \times 20.57^2) + 2.75 \times 19.07^2$
$= 1481 + 5 + 951 + 1000 = 3437.$

$S_t = \frac{3437}{20} = 172$ tension flange.

$S_c = \frac{3437}{21.38} = 160$ compression flange.

Now $M = f\ s$.
= 16,000 (172) tension side.
= 2,752,000 in. lbs. = 229,333 ft. lbs.
= 10,000 (160) compression side.
= 1,600,000 in. lbs. = 133,323 ft. lbs.

The top or compression flange is evidently the weaker and will have to govern; 10,000 lbs. fiber stress for compression in a flange 70 ft. long is entirely too high *except* that the stiffening effect of the through window posts would seem to make it safe.

(h) To determine P the safe load per lineal foot for tension of side girder, see sketch Fig. 11.

$P = \frac{2M}{b^2 - a^2}$ from $M = \frac{P}{2}\,(b^2 - a^2)$.

Where M is moment at center, b is ½ distance center to center of trucks and a is body overhang.

$$P = \frac{2M}{b^2 - a^2} = \frac{2(229333)}{758} = 605 \text{ lbs. per ft.}$$

70 × 605 = 42,350 lbs. per girder = 84,700 lbs. per car (safe load), carried by two side girders with maximum fiber stress in tension of 16,000 lbs. per sq. in.

To determine P for compression in side girder.

$$P = \frac{2(133{,}333)}{758} = 352 \text{ lbs. per ft.}$$

Safe load = 352 (70) = 24,640 lbs., say 25,000 lbs. each, carried by two side girders with maximum fiber stress 10,000 lbs. per sq. in. in compression.

= 50,000 lbs. per car.

Since the compression flange of side girders is considerably stiffened by through window posts, it is safe to assume total load on side girders as 60,000 lbs. per car. Adding to this 12,600 lbs. supported by center sills, makes a total of 72,600, or say 75,000 lbs. that the car frame will safely carry. Possibly 5,000 lbs. of the total weight of the body will be concentrated at or near each transom (including weight of body bolsters, center plates, side bearings and other fixtures), and moreover, while the whole load has been assumed to be uniformly distributed, as a matter of fact, the portions overhanging each truck will weigh more per lineal foot than the central parts, thus reducing still further the positive bending moment at the center, and increasing the capacity at this point.

It is true our calculations take no account of pulling or buffing forces, but since our fiber stresses are one-half or less the elastic limit of medium steel, and for the reason that all such forces are distributed over the whole frame by means of the large floor plate extending from each transom to its nearest end sill, the structure would seem to be amply strong.

While the center sills could be made much stiffer by using additional top and bottom cover plates instead of lattice bars, the proportion of the total load borne by them is probably near their capacity as above determined, because practically the whole side and roof framing is supported by the side girders. Moreover, lattice bars have the advantage of making all connections on sides of 12-in. channels easily accessible from below, which would not be the case were a bottom cover used in addition to the top plate.

Deflection of side frame.

(a) Load per lineal inch $= \frac{30{,}000}{840} = 36$ lbs. per in.

(b) I = 3437.

$\therefore v = \frac{2.5}{2.8}(1.06)$
$= .9$ in.

It should be remembered that the main side girder *below* the windows is securely tied to the lesser girder *above* the windows, and that both must deflect together and to the same extent. This upper girder will strengthen very considerably the lower girder.

However, since each side girder and the center sills deflect approximately 1 in. under the above loads (which represent little more than the dead weight of body), it is recommended that at least two truss rods be used to give the frame a slight upward camber.

REVISION OF STANDARDS AND RECOMMENDED PRACTICE.

The committee on revision of standards and recommended practice considered 27 changes in the existing code and submitted in its report recommendations as to the action which should be taken by the association. The report is signed by W. P. Appleyard, Chairman; T. W. Demarest and T. S. Lloyd.

REVISION OF AIR-BRAKE AND SIGNAL INSTRUCTIONS.

The joint committee of the Master Car Builders' Association and the American Railway Master Mechanics' Association appointed to revise the existing code of air-brake and signal instructions, presented a report in the form of a new set of rules covering modern air-brake and signal equipment. The report is signed by William McIntosh, A. J. Cota, A. W. Gibbs and W. S. Morris for the Master Car Builders' Association, and by A. J. Cota, representing the Master Mechanics' Association.

TESTS OF M. C. B. COUPLERS.

The committee obtained two couplers with the new contour lines adopted as standard Jan. 1, 1904, and had them applied to cars for a service test. The trial included the two couplers with new contour lines coupled passing around curves, and coupling and uncoupling on tangent and on curve; a similar trial was made with a coupler having the new contour lines coupled to one with the old contour; and still another trial under like conditions, using a badly worn coupler with the old contour lines and one with the new contour. In all instances the action of the couplers with the new contour proved satisfactory and no trouble was experienced on curves.

These same couplers, after being removed from the cars, were given a test to determine the maximum amount of angling between the center lines of the couplers, which clearly demonstrated that the new contour lines afforded a slightly increased amount of angling. From the experiments that have been made with the new couplers, the committee is satisfied that no difficulty will be experienced with the new contour lines adopted last year to take effect Jan. 1, 1904. As the designs of these gages are giving satisfactory service and have developed no defects, the only change the committee recommends is to give the gages the contour adopted Jan. 1, 1904, and to have the year "1904" cast in raised figures on the frame. These changes are shown herewith.

Upon examination of a large number of couplers and after carrying out a series of experiments with worn couplers, it was found that the controlling feature that allows the couplers to part is the distance from the point of the knuckle to the guard arm. The points of greatest wear are the inside face of the knuckle, the lock and the knuckle pin, enlargement of the knuckle-pin hole, the distortion of the guard arm and the opening of the knuckle. All these features affect the distance between the point of the knuckle and the guard arm, and it is this distance, as has been said before, that allows uncoupling. The wear on the outside face of knuckle and coupler body opposite the pivot pin is another point to be considered, but as this is very slight, and as the wear of the other parts takes place so much more rapidly, it can for interchange purposes be neglected.

The knuckle failures at the link pin hole and slot are due to the old design and have been overcome by the adoption of the solid knuckle, and although the wear on the inner face of the knuckle affects, to a certain degree, the breakage of the slotted knuckles at these points, it has been found from an examination of a number of broken knuckles that a large percentage of these have less wear than a great many knuckles remaining in service; furthermore, this distance from the inner face of the knuckle to the head does not gage the wear alone, but includes the distortion of the knuckle. This gaging distance can be omitted and a gage embracing the distance allowable from the point of the knuckle to the guard arm will cover all the points necessary for condemning couplers. For safety the distance from the knuckle point to the guard arm should not exceed 5⅛ in., which is practically what the present M. C. B. worn limit coupler gage allows at this point, and which would apply to couplers with new and old contour lines.

By making certain changes in the present standard wheel defect gage, so as to include

the dimension of 5⅛ in., a satisfactory worn limit coupler gage can be combined with the wheel defect gage. The present M. C. B. wheel defect gage is too wide to be used as a coupler gage. Reducing its width necessitates the relocation of the gaging points and distances for wheel defects. The gage should be narrower and the edges should be rounded off at both ends.

Drop Test Machine.—The M. C. B. drop-test machine, with the modifications described in the report for 1903, for Purdue University, has been completed and stands

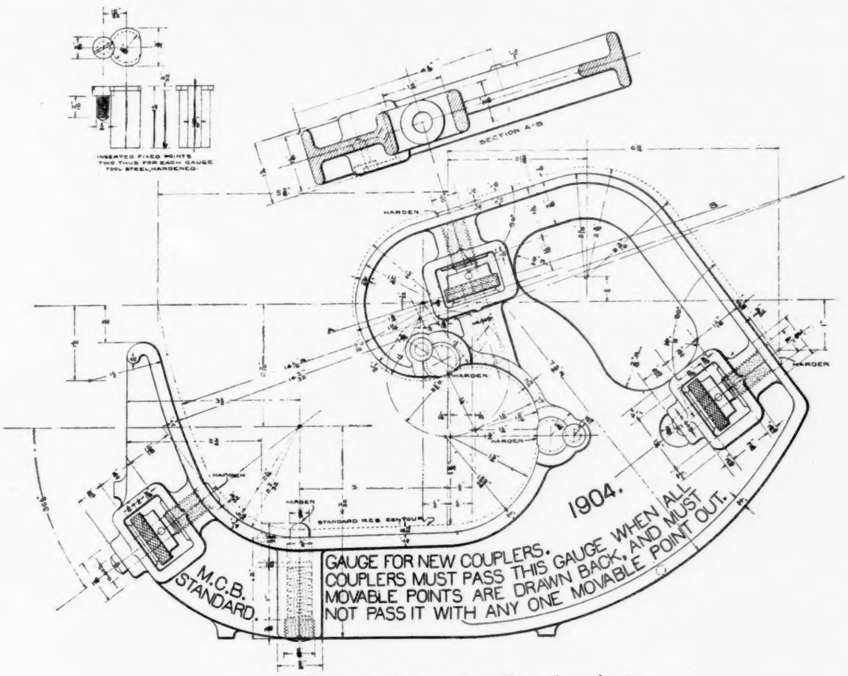


Fig. 1—Gauge for New Couplers.

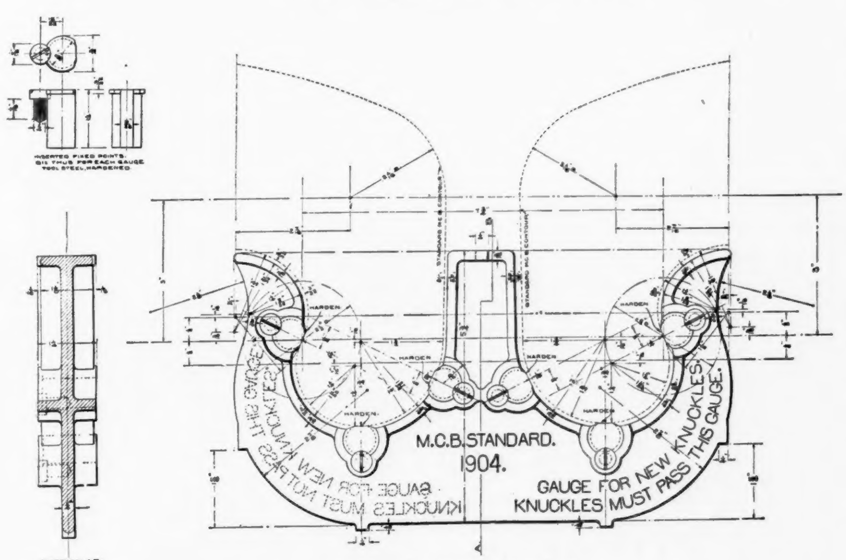


Fig. 2—Gauge for New Knuckles.

on its foundation at Lafayette, Ind., ready for operation. The committee has given it a trial test and found that the machine is entirely satisfactory and especially so as regards the single coupler jerk test. A number of knuckles were tested and the fractures showed a great variation of material, some having fine grain steel as though the knuckle had been well annealed, while others showed a large crystalline structure as if the knuckle had not been annealed. One make of knuckle appeared to be made of malleable iron, malleableized to a depth of $^1/_{16}$ in.; another style showed very poor design, it having the tail cored out until the walls were about ½ in. thick, and in one of the latter the core had floated, leaving the wall but ⅛ in. thick on one side and ⅝ in. thick on the other.

The knuckles were considered as having failed if a crack 1 in. long developed or a crack opened more than $^1/_{16}$ in., or if some portion was broken. The very wide difference in the knuckles tested shows conclusively that specifications for the separate knuckle test should be instituted at the earliest possible date, and with this end in view the committee recommended specifications.

The report is signed by R. N. Durborow, Chairman; Jos. Buker, W. S. Morris, W. P. Appleyard, F. H. Stark.

The French railroads in 1902 used 6,050,000 tons of coal, at an average cost of $3.74 per ton. More than two-fifths of this coal was imported, and this cost on the average $4.05 per ton.

Exhibits at the Saratoga Conventions.

The exhibits at Saratoga this year are quite as elaborate and equal in number to the exhibits of previous years. The following is a partial list of exhibits in place up to Tuesday night. The remainder placed during the week will be printed in another list next week:

Acme Railway Supply Co., Chicago.—Samples of Acme vestibule diaphragms.

The Adams & Westlake Co., Chicago.—Large, handsome pavilion in cream and gold surmounted by gilded dome studded with 2,000 2-in. glass bull's-eyes and 30 8-in. glass bull's-eyes; the whole lighted by 118 acetyline gas lamps supplied from five Adlake generators. Within the pavilion were the various kinds of car fixtures and chandeliers for acetylene lighting, and two Adlake generators for exhibition purposes.

American Steam Gauge & Valve Mfg. Co., Jamaica Plain, Boston, Mass.—Locomotive steam gages, locomotive pop safety valves (muffled and open), American-Thompson improved steam engine indicator, recording gages, chime whistles, test pumps and locomotive water gages.

American Brake-Shoe & Foundry Co., New York City.—Samples of the different types and styles of brake-shoes made by this company.

Anti-Friction Bearing Co., Pittsburg, Pa.—Samples of Hartman ball-bearing center plates and side bearings.

William C. Baker, New York.—Single coil fireproof heater showing two distinct circuits with steam on one coil; Mighty Midget, perfected double coil, riveted "fireproof" double coil heaters and exhibit of extra heavy fittings, combination cocks, draw-off cocks and safety vents.

Bettendorf Axle Co., Davenport, Iowa.—Exhibits of 30-ton and 40-ton Bettendorf cast-steel freight truck, passenger truck side frame, 30-ton and 40-ton body and truck bolsters, brake-beams and section of steel underframe for freight cars.

S. F. Bowser & Co., Ft. Wayne, Ind.—Exhibit of Bowser three-measure, self-measuring oil tanks and pumps; shop and gasoline tanks.

Chas. Bridgeford, Rochester, N. Y.—Heavy double axle lathe.

Buckeye Steel Castings Co., Columbus, Ohio.—Sample "Major" coupler, mounted to show operation, and also steel castings of all descriptions.

Buffalo Brake Beam Company, Buffalo, N. Y.—The Buffalo brake-beam.

Buffalo Forge Co., Buffalo, N. Y.—A Buffalo electric driven down draft forge.

The Carborundum Co., Niagara Falls, N. Y.—Cases containing carborundum products, carborundum wheels, stones and carborundum fire sand for lining brass furnaces.

The Celluloid Co., New York City.—Samples of "Texoderm" for upholstering and car curtains.

L. C. Chase & Co. (Sanford Mills), Boston, Mass.—A full line of samples of Mohair plush for upholstering car seats, also "Chase Leather" (an imitation leather) for upholstering and car curtains.

Chicago Car Heating Co., Chicago.—Vapor car heating apparatus under steam, which is described elsewhere in this issue.

Chicago Electric Hose Co., Wilmington, Del.—Samples of rubber hose for water, pneumatic, air-brake, signal and steam lines, made under a new process.

Chicago Pneumatic Tool Co., Chicago, Ill.—Sample line of Boyer pneumatic hammers. Boyer and "Little Giant" piston air drills, yoke riveter, pneumatic painting machine, stay bolt cutter, rock drills, stone dressing machines, sand sifter, grinders, air compressors, hoists, Welles gas system forges and furnaces.

Cleveland Car Specialty Co., Cleveland, Ohio.—Exhibit of pressed steel carlines.

Commercial Acetylene Co., New York.—Exhibit of acetylene gas lighting fixtures and apparatus for the storage system under high pressure. The chandeliers in the main parlor of the Grand Union will be lighted for the convention week by acetylene gas supplied from one large holder. A new application for acetylene gas is shown in connection with a two-blade, gas signal installation of the Hall Signal Co. The semaphore lamps will be lighted by ⅛ cubic feet burners supplied from an acetylene gas storage tank.

Consolidated Car Heating Co., Albany, N. Y.—Full line of car heating apparatus, including Sewall and Consolidated couplers, steam traps, steam drums and valves.

Crosby Steam Gage & Valve Mfg. Co., Boston, Mass.—Recording gages, steam and hydraulic gages, safety valves, locomotive chime whistles, globe, angle and gate valves,

muffled pop safety valves, indicators and other steam specialties.

Paul Dickinson, Chicago, Ill.—Sample of the "Dickinson Giant" cast-iron smoke-jack for roundhouses, and a model of the Dickinson movable smoke-jack.

Duner Co., Chicago, Ill.—Water closets for railroad cars.

The O. M. Edwards Co., Syracuse, N. Y.—Models of window fixtures and models of automatic extension platform trap doors.

The Fabrikoid Co., Newburg, N. Y.—Samples of "Fabrikoid" leather for upholstering and curtains.

Fairbanks, Morse & Co., Chicago, Ill.—A 6 h. p. gas engine direct connected to a dynamo furnishing power for an electric power pump; a number of duplex steam pumps, gasoline air compressor, Barrett jacks, hydraulic jacks, rail bender and samples of tinware, oil cans, etc.

Farlow Draft Gear Co., Baltimore, Md.—Samples of the Farlow draft gear.

Federal Mfg. Co., Elyria, Ohio.—Working models of Keeler curtain fixtures.

Forsyth Bros. Co., Chicago.—Samples of the Chaffee draw-bar centering device, Yerk sliding yoke, Stucki "Radial" draw-bar controlling device, "Safety" deck sash ratchet.

Franklin Manufacturing Co., Franklin, Pa.—Magnesia boiler lagging, asbestos goods of all kinds, including asbestos dust guards, journal box packing.

Franklin Railway Supply Co., Franklin, Pa.—Sheedy cylinder circulator, McLaughlin lock nuts, McLaughlin metal flexible conduit, Worthington coupler, Elvin driving box lubricator, Player brake-shoe.

The General Pneumatic Tool Co., Montour Falls, N. Y.—Exhibit of pneumatic and electric hoists.

The Gold Car Heating & Lighting Co., New York City.—A complete car heating apparatus on the Gold system in operation.

The Gould Coupler Co., Depew, N. Y.—Roller side bearings, steel platform and vestibule, spring buffers, journal boxes, tender and freight couplers, self-contained friction draft gear for freight and passenger cars.

The Hale & Kilburn Co., Philadelphia, Pa.—Exhibit of car seats.

H. G. Hammett, Troy, N. Y.—Richardson and Allen-Richardson balanced slide valves, oil cups, "Sansom" bell ringer, link grinders and Trojan metallic packing, triple valve bushing roller.

Hancock Inspirator Co., New York City.—Inspirators, injectors, strainers, boiler washers, special steam valves and double checks with stop valves for locomotive use.

Handy Car Equipment Co., Chicago.—Full-size locomotive pilot equipped with the Handy horizontally-swinging pilot coupler. Samples of the Snow wrecking frogs.

Heywood Brothers & Wakefield Co., Wakefield, Mass.—Car seats and parlor car chairs.

Holland Co., Chicago, Ill.—Dake compressed air and steam engines and motors for operating locomotive turntables, fans, blowers, hoists, portable machines, etc.; Martin flexible joints for steam, air, oil and other liquids, especially adapted for connection between locomotive and tender; Dake pneumatic hoist, Scott rail anchor, Holland fuel oil regulating valve and oil conduit for connection between engine and tender.

Homestead Valve Mfg. Co., Pittsburg, Pa.—A large gilt model of the Homestead locomotive blow-off valve; also samples.

Hunt-Spiller Manufacturing Corporation, Boston, Mass.—Samples of Hunt-Spiller "gun-iron," especially suited for locomotive castings.

Ingersoll-Sergeant Drill Co., New York.—Class H. C. air compressor, Haeseler "Axial valve" pneumatic chipping and riveting hammers, pneumatic drilling machines, quick-acting hose coupling, Ware adjustable vise, MacDonald riveting forge, Pedrick & Ayer pneumatic hoist, riveter and punches, Foley pneumatic anvil and "Antipeel" hose.

The H. W. Johns-Manville Co., New York City.—Samples of asbestos and magnesia products; also roofing and building materials, steam packings, Vulcabeston, molded mica, fireproof cements, boiler and pipe coverings, etc.

John Lucas & Co., Philadelphia, Pa.—Samples of prepared paints.

McConway & Torley Co., Pittsburg, Pa.—Exhibit of Kelso couplers and the Pitt coupler, the latest product of this company, which combines a lock-set, a lock to the lock and an automatic knuckle opening feature; also, the Buhoup 3-stem coupler equipment for freight cars.

McCord & Co., Chicago, Ill.—Outside dust guard, McCord journal box, Climax and National journal boxes, "Center Bearing" journal box lid, McCord spring dampener, McKim gaskets, McCanna force feed lubricator, McCord draft gear.

Manning, Maxwell & Moore, New York City.—Appliances made by Ashcroft Mfg. Co., Consolidated Safety Valve Co., Hancock Inspirator Co., and Metropolitan Injector Co.

The Mason Regulator Co., Boston, Mass.—Steam specialties.

Merritt & Co., Philadelphia.—Combination sheet steel ventilated, dustproof and expanded metal lockers.

Metropolitan Injector Co., New York City.—Injectors, ejectors, water heaters and hose strainers.

Michigan Lubricator Co., Detroit, Mich.—A new triple sight-feed lubricator with automatic safety device to prevent injury from blowing out of glasses; also a new glass may be put in and filled with water without closing throttle or interfering with any of the other feeds; new bull's-eye triple feed lubricator.

The Midland Supply Co., Chicago.—Samples of the Perry roller side-bearing.

National Car Coupler Co., Chicago, Ill.—Models of National steel platforms and buffers, freight and passenger couplers, National centering yoke, Hinson draft gear and friction buffers, Hinson emergency knuckle.

The National Lock Washer Co., Newark, N. J.—Full-size models of curtain fixtures, sash locks and sash balances and lock washers.

National Malleable Castings Co., Cleveland, Ohio.—Tower and Climax couplers in malleable iron and steel, engine and tender couplers and pocket castings.

A. O. Norton, Boston, Mass.—Ball-bearing lifting jacks, journal, bridge and track jacks.

Norton Grinding Co., Worcester, Mass.—Exhibiting a locomotive crank pin and piston rod, ground on the Norton plain grinder.

Philips, Justice & Co., Philadelphia.—Exhibit of the "Reliance" jacks.

Spencer Otis Co., Chicago, Ill.—Republic friction draft gear.

Pantasote Co., New York City.—Model of section of a passenger car showing seats and curtains of "Pantasote" leather.

Pittsburg Spring & Steel Co., Pittsburg, Pa.—Samples of elliptic and spiral car and locomotive springs.

Rand Drill Co., New York City.—Full line of Imperial pneumatic tools; also Rockwell portable oil rivet forge, duplex steam, compound air, type 10 air compressor, compound type 10 compressor driven with Morse chain driven by a Westinghouse 50 h. p. motor, and fitted with the Cutler-Hammer starter and passenger equipment; springs, coil and elliptical, type 11 compressor and a belt driven type 11 compressor.

Robins Conveying Belt Co., New York City.—Model of the Robins belt conveyor for handling all kinds of material and fitted with Richardson automatic scales.

Safety Car Heating & Lighting Co.—Booth showing various designs of overhead and bracket Pintsch gas lights. This exhibit occupied a prominent place in the corridor of the Grand Union Hotel.

Simplex Railway Appliance Co., Chicago.—Samples of "Simplex" 100,000, 80,000 and 60,000-lbs. capacity body and truck bolsters and "Simplex" I-beam tender truck bolster; also "Simplex" brake-beams for all service, and "Susemihl" roller side-bearings for freight and passenger equipment; springs coil and elliptical for all classes of equipment.

Louis A. Shepard, New York.—Cast-steel bolsters and brake-shoes. Representing Benj. Athar & Co. and South Baltimore Steel Car and Foundry Co.

Sherwin-Williams Co., Cleveland, Ohio.—Samples of railroad paints and varnishes.

Standard Car Truck Co., Chicago, Ill.—Models of trucks fitted with Barber roller bearings for lateral motion.

Standard Coupler Co., New York City.—Standard steel platform, Sessions-Standard friction draft gear and Standard couplers.

Storrs Mica Co., Owego, N. Y.—Mica headlight chimneys and lantern globes.

The T. H. Symington Co., Baltimore, Md.—Samples of the Symington patent journal boxes and dust-guards; also a full-size working model driven by a G. E. motor showing the comparative action of the waste and oil in the Symington and standard M. C. B. journal boxes.

U. S. Metal & Mfg. Co., New York City.—Combination steel draft gear and underframe, U. S. steel truck, Johnson hopper door, Camel adjustable journal bearing, Dunham hopper door, Columbia lock nut, Perfect pressed steel car replacer, Cliff and Guibert safety automatic hose reels, malleable iron brake jaw.

Walworth Mfg. Co., Boston, Mass.—Locomotive injectors, wrenches, pipe cutters, steam whistles, stocks and dies, pipe vises, taps and cutters and Smith's track ratchet.

West Disinfectant Co., New York City.—Samples of chloro-naptholeum, Taussig automatic and Protectus disinfectors, improved W. D. C. bug exterminator, especially adapted for railroad coaches and dining cars.

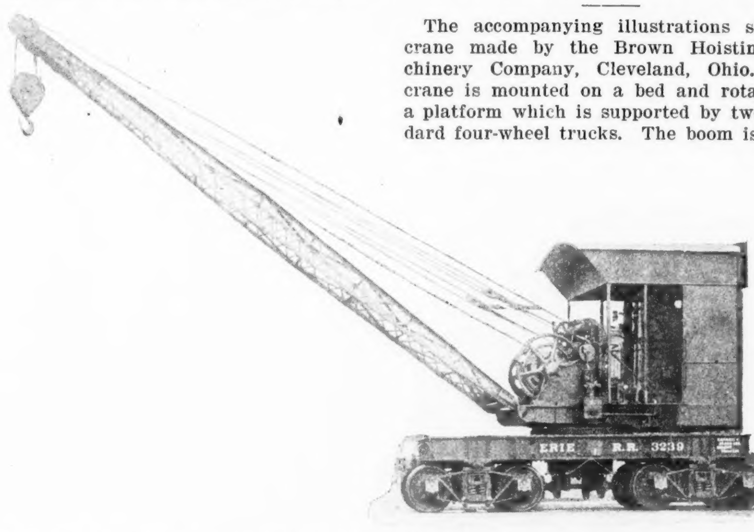
Western Tube Co., Kewanee, Ill.—Samples of "Kewanee" brass and iron ball-joint unions from ½ in. to 3 in.

The Westinghouse Air Brake Co., Pittsburg, Pa.—The American Brake Co., St. Louis, Mo.; Westinghouse Automatic Air and Steam Coupler Co., St. Louis, Mo.; Westinghouse Electric & Mfg. Co., Pittsburg, Pa. Two quarter-size four-wheel car models fitted with Westinghouse air-brake: Westinghouse friction draft gear, Westinghouse automatic air and steam coupler, American automatic slack adjuster, Westinghouse high speed reducing valve, Westinghouse track shoe brake, etc.

Yale & Towne Mfg. Co., New York City.—Exhibit of Triplex hoists and Blount door checks.

A Self-Propelled Yard Crane.

The accompanying illustrations show a crane made by the Brown Hoisting Machinery Company, Cleveland, Ohio. The crane is mounted on a bed and rotates on a platform which is supported by two standard four-wheel trucks. The boom is 35 ft long and has a capacity for lifting from 20,000 lbs. at an 8 ft. radius to 5,800 lbs. at a 35 ft. radius. The crane will swing these loads through a full circle without being clamped to the tracks. A full load can be hoisted at 42½ ft. p. m., and the truck travel of the crane at full load is about 500 ft. p. m. The crane is equipped with a pair of vertical 9 in. x 7 in. cylinders, coupled at right angles. The boiler is the vertical tubular type 54 in. in diameter, 8 ft. 3½ in. high and has 98 tubes each 2½ in. in diameter. The drums are driven directly from the main engine shaft by a train of cast steel gearing. Both drums can be turned either independently or at the same time. One drum operates the closing rope of the bucket and the other drum operates



Self-Propelled Crane Built by the Brown Hoisting Machinery Company.

the bucket holding rope. The Grafton patent rotating gear is used for swinging the boom. This consists of a steel pinion, controlled by friction clutches meshing into a slip-ring of large diameter, whereby rotation in either direction may be accomplished without reversing the engines. This slip-ring is made of rolled steel, and has teeth cut in its periphery. The ring rests loosely on a bearing on the upper surface of the truck. The upper surface of the slip-ring, which is beveled, forms the path or bearing for the conical rollers carrying the superstructure. There are six of these rollers—four in front to take the thrust of the boom, and two in the rear. The slip-ring is free to move in either direction, when the rotating-clutch is thrown into gear, but is retarded in this motion by the frictional resistance between the ring and its seat, due to the weight of the crane superstructure and load resting upon it. The action of the slip-ring is therefore that of a safety when rotating the crane under light or heavy loads, and the resistance of the ring to rotation is directly proportional to the load hanging on the crane.

Coaling Locomotive With Crane.

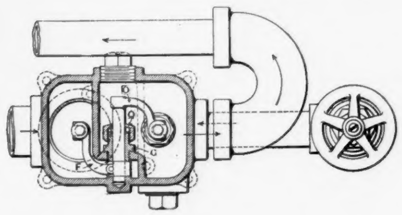
The traveling mechanism is taken by a clutch operating through bevel-gears and driving a vertical shaft in the center of the crane, which passes downward through a hollow-steel center-pin, which unites the upper and lower base of the crane and forms the axis of rotation. The lower end of this vertical shaft has a bevel-pinion gearing into a bevel-wheel mounted on a horizontal longitudinal shaft running between two truck-axles, one on each truck. Each end of this shaft has a bevel-pinion meshing into bevel wheels on the respective truck-axles. The bevel-wheels on both axles are split, and are easily detached. The horizontal shaft is coupled by means of steel universal couplings to allow the crane to travel around curves when operated under its own power.

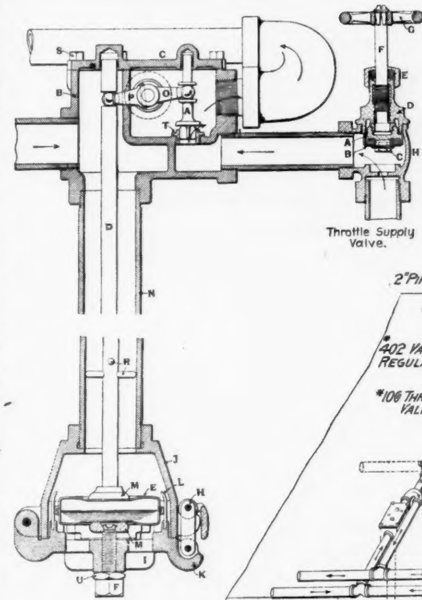
The bevel wheels on the truck axles are arranged with a clutch so that they can easily be thrown out of gear. The boom is raised and lowered by means of a train of gears which are in control of the operator through a positive clutch. The radius can be varied from 12 ft. to 35 ft. The space required for rear overhang of crane is 9 ft. 8½ in. The crane is equipped with a Brown patent two rope grab bucket of 54 cu. ft. capacity. This bucket is of special design, particularly adapted for coaling locomotives directly from cars. The pitch of the blades is such that in closing they do not dig into the pile of coal but scrape the pile off level. This permits getting all of the coal out of the car. The bucket has separate ropes for opening and closing the blades. The crane is supplied with hand brakes, a water tank with a capacity of 200 gal., and space for 600 lbs. of coal. The extreme height of the crane from top of rail to top of smoke stack is 18 ft., the extreme width 8 ft. 6 in., and the length of truck over all is 22 ft. The height of the crane can be reduced to 16 ft. by lowering the stack, which is hinged. The weight of crane is approximately 95,000 lbs.

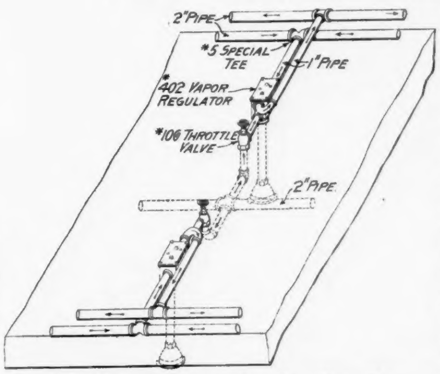
One of these cranes is used at the Cleveland shops of the Erie Railroad. The average amount of coal handled by it in a day of 12 hours is 168 tons, and the average number of trips made per hour is 52. The average cost per ton is $2^1/_7$ cents, as against 12.1 cents per ton compared with methods previously employed. The best record made with the crane was the handling of 180 tons of coal in a day of 12 hours.

Vapor System of Car Heating.

A new system of car heating involving principles radically different from any now used is shown in the accompanying engravings. The scheme in general provides for the circulation in the radiating pipes of each car in the train of steam or vapor at 212 deg., to give a uniform temperature throughout the train regardless of variations in the train-pipe pressure. The apparatus contains no novel mechanical features, only slight changes from details already in general use being required. The well-known expansion trap mechanism is employed, with an admission valve substituted for a discharge valve. The conditions existing at the outlet chamber containing the diaphragm are unchanged, but an important difference is that this expansive diaphragm is used to open and close automatically a valve in the branch pipe supplying steam to the radiating pipes inside the cars, instead of a trap valve. The passage for the discharge of condensation is left open to the atmosphere.







Vapor System of Car Heating—Chicago Car Heating Co.

When the steam entering from the train pipe has circulated through the radiating pipes and finally reaches the outlet, it expands the diaphragm, which shuts off the supply. It then instantly contracts enough to allow just sufficient steam to enter the radiating pipes to make up for what is being condensed. This condition continues as long as steam is on the apparatus. Therefore, the temperature of the outlet of the apparatus, containing the diaphragm, is maintained at about 200 deg., and consequently all the pipes between the outlet and the inlet are maintained at a temperature varying from 200 deg. at the outlet to about 212 deg. at the inlet. As the radiating pipes are open to the atmosphere, their temperature cannot exceed 212 deg. at the hottest point.

The details of operation are as follows: Leaving the train pipe at the strainer cross, the steam passes through the throttle supply valve and the automatically-operated regulating valve, A, in the intake chamber of the vapor regulator. Until the steam reaches the valve A it is, of course, at train-pipe pressure. From the vapor regulator it passes through the usual feed pipe into the radiating pipes inside of the car, and circulating through them, finally reaches the outflow chamber of the vapor regulator, passes down the tube N and around the expansive diaphragm to the atmosphere.

The vapor regulator is divided by a partition into two parts—an intake and an outflow chamber, so that steam entering the device at valve A has to pass entirely through the radiating pipes before it reaches the outlet and comes in contact with the expansive diaphragm. Motion from the diaphragm at the outlet, to the automatic valve A at the inlet, is transmitted through the dividing partition by means of the lever, O, passing through the stuffing box, Q. The difference in pressure on the two sides of this stuffing box is inappreciable and as the motion of the axis of the operating lever is almost nothing, the stuffing box is a feature which needs no attention after the device is in service. The maximum movement of the valve A is ¼ in. The weight of the rod D will keep the valve open when the diaphragm is cold. The strainer cross on the train pipe prevents dirt, scale, pieces of rubber hose, etc., from passing out of the train pipe into the automatic regulator valve, A, and interfering with its proper working. The throttle supply valve is designed to permit steam to be forced back to the rear of train rapidly.

From results thus far obtained with this system, the apparatus has proved to be entirely automatic and quite simple. There being no pressure on the radiating pipes, the possibility of burst pipes is avoided. The radiating pipes being open freely to the atmosphere require no steam-traps or drip-valves. Also, there are only two valves to operate.

This system is the invention of Mr. Egbert H. Gold, President of the Chicago Car Heating Company, Chicago. It has been under test continuously during the past winter, and the company states that these tests have substantiated all of its claims.

Steel Car Design.

II.

BY A. STUCKI.

Truck Bolsters.—In designing the sections for truck bolsters, maximum moments only should be considered. Between the center of the bolster to the point R (Fig. 4), the

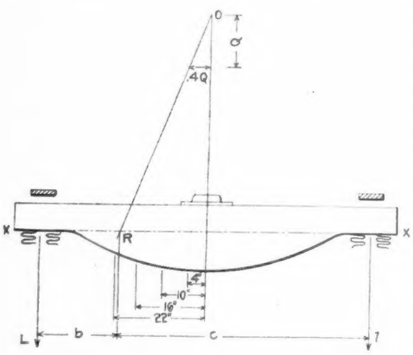


Fig. 4.

maximum moments can be obtained by assuming a horizontal force of such magnitude that it brings the intersection of the resultant of the horizontal and vertical forces, with the line x-x, into the vertical plane for which the section moment is to be found. The point R corresponds with a horizontal force of .4 Q, which is the greatest horizontal force which need be considered.

Example: To obtain the moment of an 80,000-lb. truck bolster at a point 10 in. from the center with the bolster springs spaced 76 in. apart. The vertical force is Q^1, which is half the load, half the weight of the car body and the weight of the truck bolster. For an 80,000-lb. car this is 56,500 lbs. Consider this force as applied 10 in. to the left of the center. Then, taking moments about the right-hand spring, the load on the left-hand spring will be

$$\frac{56,500\left(\frac{76}{2}+10\right)}{76} = 35,684 \text{ lbs.}$$

The section moment, 10 in. to the left of the center, will be 35,684 × (38—10) = 999,152 in. lbs.

The moments for a number of sections are tabulated below for the three standard capacity cars:

	60,000 lb. cars in. lbs.	80,000 lb. cars in. lbs.	100,000 lb. cars in. lbs.
In the center	825,000	1,073,500	1,328,200
4 in. from center	815,600	1,062,000	1,314,000
10 in. from center	766,300	999,200	1,238,000
16 in. from center	674,800	883,200	1,099,000
22 in. from center	541,000	713,700	894,500

Since the center plate distributes the load uniformly for some distance on each side of the center, the moment at that point can be disregarded and the moment at a point 4 in. to one side of the center can be taken as a maximum. The bolster can, therefore, be made straight for 8 in.

In determining the section modulus at the center, the center pin hole in the cover plates of built-up bolsters is compensated for by the center plate, provided enough rivets are used in the center plate. The holes for machine-driven rivets in built-up bolsters need not be deducted from the effective cross-sectional area for compression in calculating the section modulus.

The moments in the bolster between the point R and the end of the bolster are more easily obtained than those between R and the center. The maximum load on the springs remains the same in all cases and corresponds to the values of L used in designing the arch-bars. The moments are directly proportional to the distance of the section for which the moment is to be found, from the center of the spring.

Example: The moment for a 100,000-lb. truck bolster, 9 in. from the center of the spring is L × 9, or 45,700 × 9 = 411,300 in. lbs.

The sections between the point R and the side bearings have smaller moments than those obtained as above. In reality, the product of the pressure between body and truck side-bearings multiplied by the distance from the center of these bearings to the section under consideration, should be deducted from the moment obtained by the other method. Ordinarily, this can be neglected and the bolster designed as above.

The fiber stress in a truck bolster should be kept low to provide for the shocks and vibrations to which this part of the car is subjected. For open hearth steel with carbon from 0.15 to 0.20 per cent., 12,500 lbs. per sq. in. is a fair figure.

Truck bolsters should be made stiff and strong, horizontally as well as vertically. The forces in a horizontal direction are closely proportional to the weights (not capacities) of the trucks. In order that the additional fiber stresses, due to end shocks, do not exceed the liberal allowance made in choosing a low fiber stress as given above, the section modulus in a horizontal direction should be made not less than 50 per cent. of that in a vertical direction. In a box girder construction, the horizontal strength is usually so manifest that a special analysis in this direction is unnecessary.

The tables give the moments of inertia and moments of resistance for the different sections commonly used in truck bolster construction. They will be found useful in preliminary work.

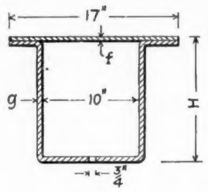


Fig. 5.

H.	f.	g.	Moment of Inertia.	Section Modulus. Top.	Section Modulus. Bottom.
11½	¼	⅜	377.0	77.3	56.9
		½	468.7	90.0	74.4
	⅜	⅜	415.6	93.4	58.9
		½	511.2	105.7	76.5
12	¼	⅜	420.5	82.2	61.0
		½	518.4	95.4	78.9
	⅜	⅜	458.9	98.4	62.5
		½	561.7	111.3	80.7
12½	¼	⅜	462.5	86.6	64.5
		½	570.5	100.7	83.4
	⅜	⅜	504.8	103.6	66.1
		½	618.2	117.3	85.5
13	¼	⅜	506.9	91.0	68.2
		½	625.8	106.1	88.1
	⅜	⅜	553.3	108.9	69.8
		½	678.0	123.2	90.4
13½	¼	⅜	553.7	95.8	71.7
		½	684.1	111.4	92.9
	⅜	⅜	604.5	114.2	73.6
		½	741.2	129.3	95.3
14	¼	⅜	602.9	100.5	75.3
		½	745.7	116.9	97.8
	⅜	⅜	658.3	119.7	77.4
		½	807.7	135.5	100.4

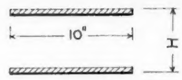


Fig. 6.

Section Modulus.

H.	t=5/16.	t=⅜.	t=7/16.	t=½.
5	13.75	16.08	18.27	20.33
5¼	14.53	17.01	19.35	21.56
5½	15.30	17.97	20.45	22.81
5¾	16.09	18.87	21.50	24.06
6	16.86	19.80	22.61	25.28
6¼	17.63	20.72	23.68	26.50
6½	18.41	21.67	24.77	27.74
6¾	19.19	22.59	25.85	28.99
7	19.98	23.55	26.95	30.24
7¼	20.76	25.05	28.05	31.50
7½	21.53	25.42	29.13	32.73
7¾	22.32	26.34	30.22	33.98
8	23.12	27.27	31.31	35.21
8¼	23.88	28.20	32.40	36.44
8½	24.65	29.20	33.49	37.69
8¾	25.41	30.16	34.58	38.94
9	26.22	31.02	35.67	40.19
9½	27.77	32.90	37.00	42.68
10	29.33	34.77	40.20	45.17
10½	30.89	36.63	42.11	47.65
11	32.45	38.48	44.39	50.15
11½	34.03	40.43	46.59	52.65
12	35.56	42.25	48.76	55.44
12½	37.12	44.11	50.92	57.60
13	38.72	46.00	53.14	60.13
13½	40.19	47.81	55.28	62.59
14	41.80	49.76	57.50	65.12

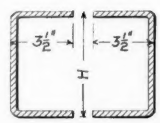


Fig. 7.

Section Modulus.

H.	t=5/16.	t=⅜.	t=7/16.	t=½.
5	11.37	13.17	14.84	16.37
5¼	12.13	14.08	15.88	17.54
5½	12.91	15.00	16.94	18.74
5¾	13.71	15.93	18.00	19.94
6	14.50	16.88	19.10	21.16
6¼	15.31	17.84	20.21	22.42
6½	16.15	18.82	21.34	23.69
6¾	16.99	19.83	22.44	24.99
7	17.83	20.00	23.67	26.31
7¼	18.71	21.86	24.85	27.66
7½	19.58	22.91	26.04	29.00
7¾	20.04	23.96	27.27	30.39
8	21.39	25.04	28.52	32.00
8½	23.85	27.25	31.06	34.67
9	25.15	29.50	33.67	37.61
9½	27.11	31.82	36.33	40.63
10	29.12	34.22	39.10	43.77
10½	31.18	36.67	41.92	46.97
11	33.27	39.20	44.83	50.71
11½	35.58	41.77	47.81	53.62
12	37.45	44.40	50.86	57.08
12½	39.49	47.16	53.99	60.63
13	41.96	49.86	57.19	64.24
13½	44.57	52.69	60.45	67.94
14	47.06	55.57	63.80	71.74

Short Truck Bolster.—In some designs of trucks the springs are not placed under the arch-bars, but are located about 27 in. from the center of the truck. In this case the bolster is much shorter and need not be made so strong. The method of analysis is precisely the same as before and need not be gone over again. The maximum load L, is, in this case, 39,100 lbs. for 60,000-lb. cars, 50,200 lbs. for 80,000-lb. cars, and 61,300 lbs. for 100,000-lb. cars. The maximum moment on these bolsters at a point 4 in. to one side

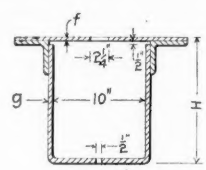


Fig. 8.

	f = 5/16. g = ⅜. Angle = 3x3x5/16.				f = 5/16. g = 7/16. Angle = 3x3x5/16.				f = ⅜. g = ½. Angle = 3x3x⅜.			
	Section as Shown.		Without King Pin. Hole.		Section as Shown.		Without King Pin. Hole.		Section as Shown.		Without King Pin. Hole.	
H.	I.	Z.	I.	Z.	I.	Z.	I.	Z.	I.	Z.	I.	Z.
11½	445.3	64.8	460.9	65.5	449.7	67.5	468.9	68.7	519.7	76.7	539.4	77.6
12	490.8	68.6	507.5	69.4	492.2	70.9	511.8	72.1	573.5	81.3	595.3	82.3
12½	537.8	72.4	555.9	73.1	542.4	75.2	562.6	76.2	630.6	86.1	654.3	87.2
13	587.7	76.3	607.4	77.0	594.2	79.4	616.1	80.5	690.9	90.8	716.6	92.0
13½	641.3	80.3	661.0	81.0	649.0	83.8	672.7	85.0	754.8	95.9	782.8	97.2
14	694.6	84.1	717.8	85.0	706.7	88.9	732.4	90.1	821.0	100.7	851.1	102.2
14½	751.5	88.0	780.7	89.4	767.2	93.0	794.8	94.3	891.7	105.9	924.3	107.4
15	813.2	92.3	840.0	94.4	833.0	97.4	862.7	98.8	966.2	111.2	1000.2	112.7

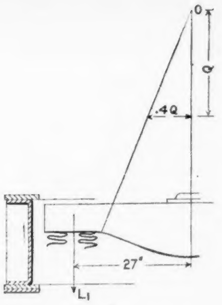


Fig. 9.

of the center is 581,000 in. lbs. for 60,000-lb. cars, 746,000 in. lbs. for 80,000-lb. cars, and 911,000 in. lbs. for 100,000-lb. cars.

(To be continued.)

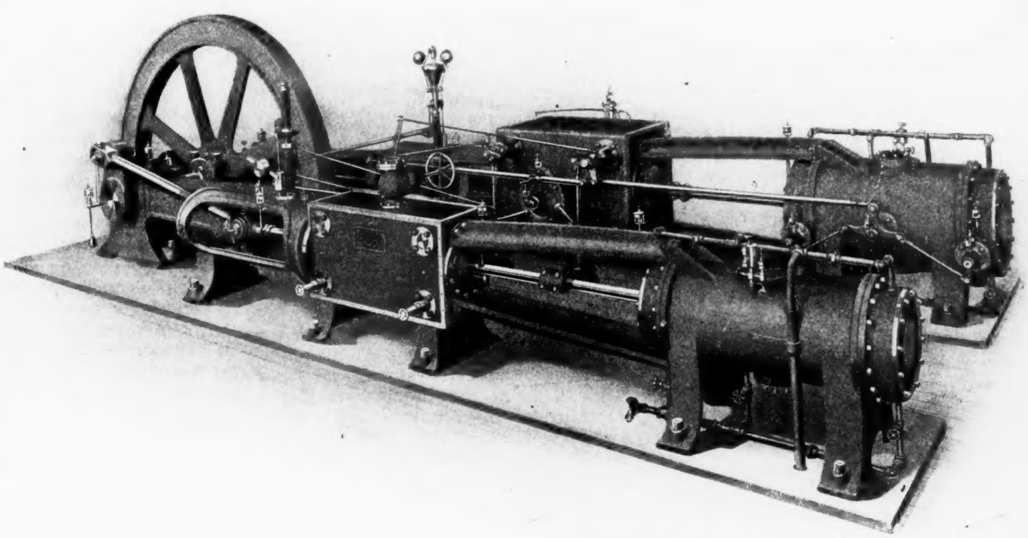
Sullivan Air Compressors for Railroads.

Careful design and construction and high economy of operation are claimed for the compressor shown in the engraving, which is the Sullivan cross-compound two-stage type. The cylinders are made of semi-steel. The studs and cap screws on the cylinder heads, valve gear, etc., are steel, and the nuts are steel, case hardened. A steam-jacketed receiver and reheater is placed between the high and low-pressure cylinders, as at low speeds condensation would be great without these accessories. The bonnets and the steam and exhaust valve levers are semi-steel. All rods in connection with the valve motion and dash-pots are made of machinery steel, turned and polished. The rods have phosphor-bronze key heads at both ends which are adjustable for wear by means of wedge blocks and set bolts. The dash-pots are semi-steel, ground with emery to an air-tight fit, so that no packing is used. The valves for the steam cylinders are semi-steel attached to the T-shaped heads of the valve stems so as to follow up wear automatically. The ends of the steam and exhaust valves toward the back of the cylinders are provided with eye-bolt holes, so that the valves may be removed through the back bonnets with eye-bolts provided for that purpose, without disturbing the valve setting. The valve stems are forged steel.

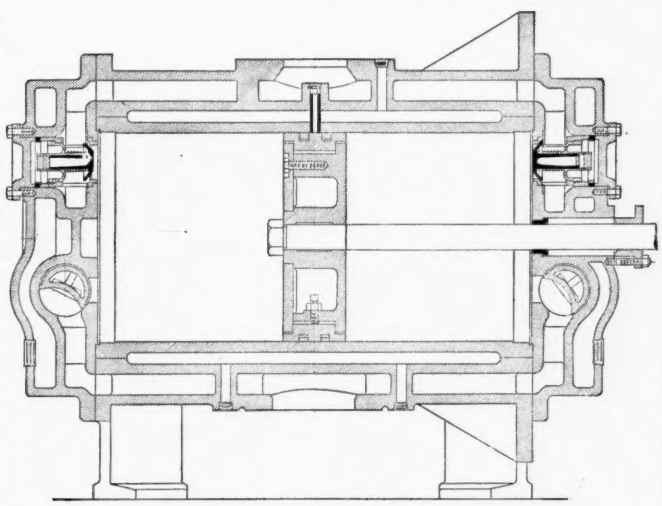
The steam governor is provided with an oil cushion cylinder and an automatic device, which stops the compressor in case the governor belt breaks. The automatic air governor operates in connection with the steam governor and automatically controls the speed of the engine. The engine frames are the girder type. The construction of the air cylinders is shown in the accompanying engraving. The cylinder casting and liner are separate, the liner being made of semi-steel. These loose liners are pressed into the bored-out cylinders with hydraulic pressure after the ends of the liners are turned to fit the cylinder bore. The end of the cylinder flanges and liners are then faced off to the same length. The loose liner is claimed to be preferable to the one-piece construction, as all shrinkage strains are avoided, and in case of injury to the liner a new one may easily be put in. Each air cylinder and head is water jacketed over its entire surface.

The pistons are semi-steel with adjustable bull rings so that the piston rods may be adjusted to line central with the engine cylinders and guide. The piston rods are hammered open-hearth steel. The intercooler between the two air cylinders is placed below the floor line. The air from the intake cylinder enters at the top of the intercooler and leaves it at the bottom, allowing accumulated moisture to be drawn off by a drain cock. The air cylinder heads are semi-steel, and water-jacketed, and contain the valve seats for the intake and discharge valves. The intake valves on both cylinders are rotary, or Corliss, type, mechanically operated by means of independent eccentrics on the engine shaft. The air outlet valves on both cylinders are the poppet type, cushioned to work without noise. The valve and valve seat, which are made of phosphor-bronze, are inside of a removable cage, and held in place by a hand hold plate. When this hand hole plate is removed, the valve cage containing the valve and seat may be removed with the hands. The pressure of the plate forms a tight joint between the cylinder head and the valve cage. Thus, when the valve seat becomes worn or leaky, it may be removed, together with the valve and cage, without disturbing the cylinder head, and a spare valve and case inserted. The worn valve seat may then be ground and fitted.

These compressors are built by the Sullivan Machinery Company, Chicago. This company also builds several classes of a straight-line type, including belt-driven designs, which are also suitable for railroad shops.



The Sullivan Air Compressor.



Air Cylinder—Sullivan Air Compressor.

Local Freight Agents' Association.

The seventeenth annual meeting of the American Association of Local Freight Agents' Associations met in Peoria, Ill., June 14th; President C. H. Newton in the chair. The delegates and their families were welcomed by Mayor Woodruff. Congressman Joseph V. Graff delivered an address on "Railroads and Our Country's Development," and Editor Baldwin, of the Peoria *Evening Star*, on "Who Pays the Freight?"

Most favorable reports were received concerning the condition of the association. During the year the following associations have been received into the Inter-American Association: St. Paul, 13 members; Pekin, 7 members; Erie, 6; Seattle, 9, and Dallas, 5. The following associations were dropped for lack of interest and non-payment of a small per capita tax: Lima, Canton-Massillon (one) and Waverly, leaving a membership of 72 local associations with an individual membership of 765. The treasurer has $1,300 on hand and owes nothing. A change was made in the constitution so that the American Association will henceforth recognize in its sessions only those actually in

charge of freight stations or piers, who shall be listed as active members. Car service managers, inspection bureau and commercial or soliciting agents, will have no voice.

The following topics were discussed by the convention, each being proposed by members from the city named: *St. Louis*—"Why Should Loaded Cars be Rejected by Connections on Account of Bad Order, Shifted Load or Over-load?" The proposer argued that the expense of transfer was the same whether performed by one line or another and that fewer cars would be transferred if the expense were borne by the receiving line; and the apparent injustice would equalize itself. The association, however, decided by a close vote that such cars should not be rejected but be received and transferred by the receiving line, and the expense paid by the delivering line.

Cleveland—"What is the Best Method of Conveying to Switching Crews Instructions for Switching Cars at Large Terminals?" The practice at many large centers was brought out and each was given as the best that that association had been able to devise. To discover a "best" that might be suited to different conditions, the subject was turned over to the incoming Conference Committee for a recommendation.

Peoria—"Best Seal." A collection of seals in use was exhibited. There was considerable discussion, but no unanimity of opinion, and this subject also was given the Conference Committee for a recommendation.

Louisville—"Uniform Blank for Recording Passing Inter-line Way Bills at Terminals." It was unanimously voted that this would be a good idea and the secretary was instructed to take up with the Accounting Officers' Association and ask it to provide a form.

Des Moines desires "an improvement in billing, that all information, including marks on packages be shown on bills of lading, full name of shipper, point of origin, rates, divisions in full; that the freight bill at destination have exactly the same information shown on B. L." The proposition was agreed to but the subject was referred to committee.

Chicago—"Classification on dry goods, boots and shoes, hats and caps, underwear, gents' furnishing goods, clothing, millinery and liquor in cases when packed in second-hand, or re-coopered cases should be given a lower class when corded and sealed." A former attempt failed to get a ruling that boots and shoes be corded and sealed; but all agreed that from their experience such an inducement would save the transportation companies in claims more than enough to justify the loss in revenue from the slight reduction in rate. The committee will make an effort to bring about the necessary change in classifications.

Pittsburg proposed a sliding scale car service (demurrage) charge, increasing with the number of days' detention. This proposition developed a two hours' discussion of the car service rules of different sections. Varying conditions prevent uniformity in application of rules, but it appeared that the greatest hindrance to good results was the interference by traffic or other officials through a lack of confidence in competitors. Where a better confidence has been established the rules are more effective and are satisfactory to both consignees and railroads. The association voted that the established uniform rate of one dollar a day is preferable to the proposed sliding rate, except that vegetables and fruits might be made exceptions where conditions require a more prompt movement.

Lincoln—On the recommendation of Lincoln the association voted that L. C. L. shipments should be weighed when conditions will permit; also that when possible freight should be received, weighed, checked and loaded at one handling.

Wheeling—"Does the training which a local freight agent receives in the faithful performance of his duties qualify him for a promotion in any other, and in what departments?" The association agreed that if the individual possessed executive or other proper qualifications, his training as an agent especially fitted him for promotion in the transportation, traffic or accounting departments.

It was recommended to the Master Car Builders in the Western, Southern, Official and Canadian Classification districts that in future doors of box cars, 36 ft. long or longer, be made 6 ft. in width.

Detroit recommended that to secure the return of chains to point of origin they be regularly billed, showing as freight the value of chain; on the return this sum could be entered as charges. This was adopted as the sense of the association.

Savannah presented an able paper, affirming the perfectly successful use of the manibill, but in view of its discontinuance by the Baltimore & Ohio, for causes given by some of the agents of that road, the association voted that it was without sufficient information to either approve or condemn it. Many expressed a firm belief in its ultimate success, if adopted with the full purpose to use it and adopt it entire; modifying the accounting methods to suit its use.

The election of officers resulted as follows: C. H. Newton (Wabash), Toledo, President; G. W. Dennison (Penna.), Toledo, Secretary; J. H. Dunlevy (P. R. R., 23d St.), Pittsburg, Treasurer.

All these were re-elections. Mr. M. A. Wheeler (L. E. & W.), Peoria, was elected Vice-President, and Minneapolis was chosen as the place for the next meeting, June 13, 1905.

This convention was of much interest throughout, 40 associations being represented by 140 delegates. An inspection of terminals by special train, trolley rides and visits to public institutions, provided entertainment for the members and their wives. At the close, the Chicago, Peoria & St. Louis tendered a special train to St. Louis to those returning by way of that city, and nearly all availed themselves of it to attend the World's Fair.

The Hancock Inspirator.

The Hancock locomotive lifting inspirator type "E" is shown in the accompanying illustration. By changing the nozzles and tubes only, the capacity of the inspirator can be made 2,500 gal., 3,000 gal., 3,500 gal., 4,000 gal., 4,500 gal., and 5,000 gal. per hour with a steam pressure of 200 lbs. per sq. in., and lifting water vertically 4 ft., with the feed water at 75 deg. F. The inspirator will feed at any pressure between 35 lbs. and 350 lbs. per sq. in. It cannot discharge the water except through the delivery pipe leading into the boiler.

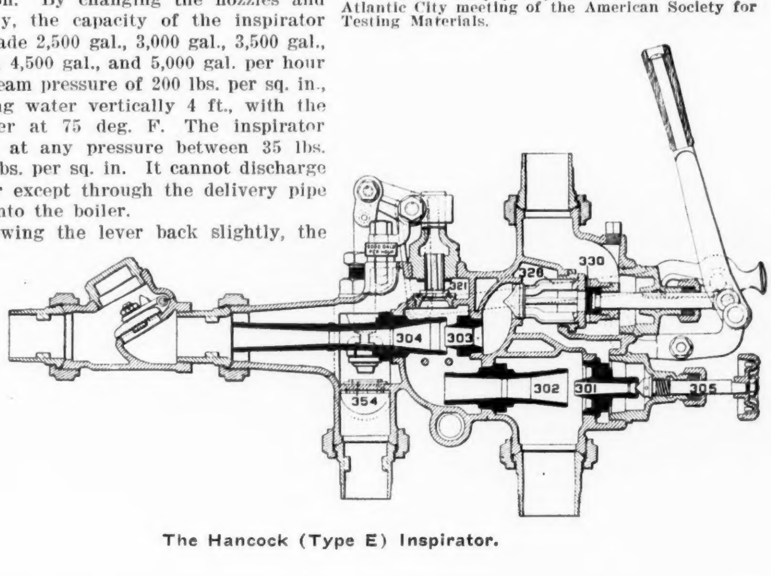
By drawing the lever back slightly, the lifter steam valve (330), is drawn from its seat, allowing steam to flow through the lifter steam nozzle (301), and through the lifter tube (302), thus lifting the intermediate overflow valve (321). The steam then passes through the opening in the final overflow valve seat (354), and the overflow pipe to the atmosphere, thus lifting the water. As soon as the water is lifted, it fills the body or shell of the inspirator. The lever is then drawn back, opening the forcer steam valve (326), allowing the steam to flow through the forcer steam nozzle (303), where it is condensed by the water in the forcer combining tube (304), driving the water in this tube with sufficient force to close the auxiliary overflow valve (321), and to overcome the boiler pressure. The lifting apparatus constantly forces the water to the forcing apparatus, and when the lever is fully drawn out, the final overflow valve (326), closes on the seat (354), and diverts the water from the overflow into the boiler. The capacity is regulated by the regulating valve (305), which increases or decreases the amount of steam going to the lifting apparatus. The stems are made of Tobin bronze, and all the nozzles, tubes, valves and valve seats are of a composition which does not contain any zinc. The inspirator is made by the Hancock Inspirator Company, New York.

Stay-Bolt Iron*

The high pressure and large boilers now used have increased the breakages of stay-bolts, and have given rise to many devices for overcoming the difficulty. The two principal difficulties are: (1) Leakage, (2) Breakage. Breakages are caused by the vibration due to unequal expansion of the inside and outside sheets. The object of flexible stay-bolts is to provide for the vibration. Such stay-bolts have not proved altogether satisfactory for the reason that with incrusting waters the ball joint becomes filled with scale and becomes rigid. They are also expensive to apply and to maintain, and usually give more trouble from leakage than the ordinary stay-bolt because the thread in the fire-box side is apt to be stripped in driving, inasmuch as there is less support for holding on, and also because of the tendency to drive them when in service without taking off the caps so as to enable the workman to hold on to the bolt.

Designers have been trying to reduce failures by increasing the length of the bolts and by decreasing their diameter. There

*Abstract of a paper by H. V. Wille, read at the Atlantic City meeting of the American Society for Testing Materials.



The Hancock (Type E) Inspirator.

are several reasons why a ⅞-in. bolt should last longer than the 1-in. bolt, notwithstanding the fact that it has a smaller area. Staybolts are not loaded to a definite fiber stress (in which case the bolt of larger diameter would be the more serviceable), but they are deflected through a given angle, and the amount to which they are deflected cannot be altered by any increase in strength or in diameter. Inasmuch as the angle through which the axis of the bolt is bent is independent of the diameter of the bolt, the outer fiber of the smaller bolts and a crack will thus start sooner in the 1-in. bolt than in the ⅞-in. bolt. The time between the starting of the crack and the breakage of the bolt will be greater for bolts of large diameter than for bolts of small diameter. However, the bolt which remains in service the shortest time after a crack is started is the more desirable bolt, for after it is cracked, the sooner it is removed the better.

A cable composed of a large number of strands will bend and twist many times without breaking, although the tensile strength is very much less than the strength of a solid bar of the same diameter. The nearer we approach to this condition in boiler design the less trouble we will have. Boilers have been built with bolts of ¾-in. diameter, but the bolts were spaced more closely than is usually the practice.

Small bolts also have an advantage in heading, for the hard hammering necessary to head a bolt of large diameter or of hard iron is liable to strip the thread of the bolt. Bolts of small diameter will not require heavy hammering and will therefore probably give less trouble from leakage than bolts of large diameter. Furthermore, the head of the bolt of small diameter would not be heated to as high a temperature as the bolt of large diameter, because it is more readily cooled by the water, and hence it would not expand as much. When the metal in the bolt expands it enlarges the hole in the sheet and puts a permanent set in the sheet and thus causes leakage. Another advantage in the use of bolts of small diameter is that they can be replaced many times without greatly increasing the diameter. The life of the fire-box would thus be increased. The future will probably see the more general use of ¾-in. bolts with closer spacing. The present practice of using a ⅞-in. bolt is a compromise between the most advanced and most conservative practice. An analysis of the stress in stay-bolts shows that the extent to which the bolt is strained increases in direct proportion to the diameter and decreases as the square of the distance between the sheets. Assuming as a basis a stay-bolt 1 in. in diameter and deflected .03 in. and a distance between sheets of 6 in., we find that the bolt has a fiber stress of 35,000 lbs. per sq. in. If the diameter is reduced to ¾ in. the stay-bolt is strained to but 26,250 lbs. By decreasing the distance between the sheets to 5 in. the bolts are strained to 50,400 lbs. for the 1-in. bolt, and 37,700 lbs. for the ¾-in. bolt. These results show very clearly the cause of stay-bolt breakage and what should be done in order to reduce the trouble to a minimum, namely make the water space as wide as possible, and use a small bolt with a closer space if necessary.

A few railroads have recently specified very high tensile strength for stay-bolt iron. The question arises, is the tensile test a proper one upon which to rate stay-bolt iron? If a member is subjected to a direct tensional strain or a definite load a high tensile strength or elastic limit is desirable because it gives a high factor of safety. If, however, a member is subjected to a definite deflection then the stiffer the iron, the greater the load necessary to produce this deflection. In other words, a bolt of high tensile strength is subjected to a higher fiber stress than a soft bolt of low tensile strength. It is for this reason that steel gives excellent results in axles, etc., which are loaded to a definite fiber stress, but it will not answer for staybolts which are bent through a given angle. The manner in which the iron is piled and rolled plays a far more important part in the life of the bolt than the tensile strength, and after many experiments, those who have given the subject thought have decided upon a fagotted bar-piled iron. The central core is composed of a number of bars, approaching in appearance a bundle of wires. This core is enclosed by an outside sheath of metal with circular fibers. This insures a good thread and prevents the bolt being strained in a direction at right angles to the fibers. A soft ductile iron piled in this way undoubtedly gives better results than a hard iron of high tensile strength piled in the usual slab form. Stay-bolt iron made in this manner may be strained by bending in a direction at right angles to the fibers, and it would then have a very low life.

This subject has been thoroughly demonstrated by making vibratory tests of various makes of stay-bolt iron, and the results obtained in the vibratory machine have been confirmed by practice. The writer's attention has recently been directed to a marked difference in the life of stay-bolts on two groups of engines of precisely the same design and in operation on the same division. Upon investigation it was found that a very high-priced special brand of high tensile strength stay-bolt iron was used in the engines which gave trouble, while a good grade of well piled soft and ductile iron was used in the engines which were giving good service. The requirements specified by a number of roads in this country, follow:

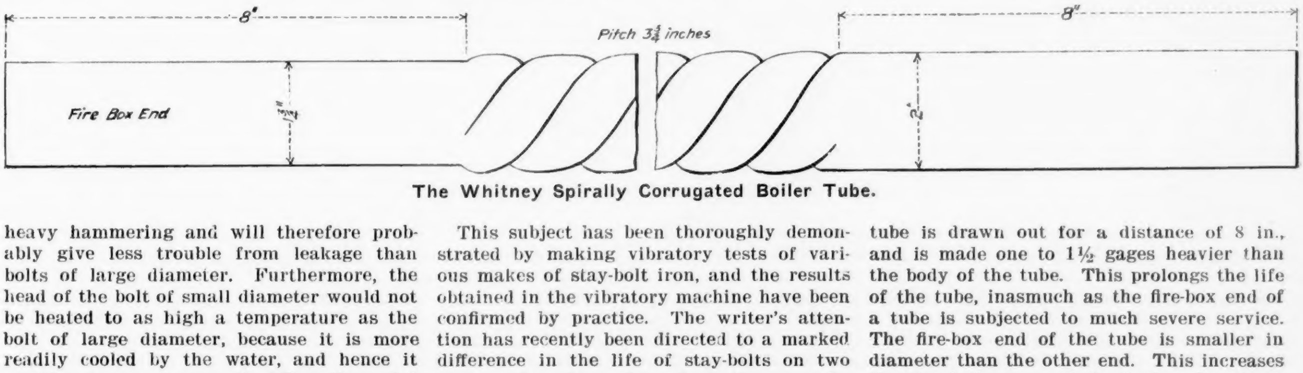
Road.	Tensile strength.	Elongation, per cent.
Atchison, Topeka & S. Fe..	48,000	28 in 8 in.
Baltimore & Ohio..........	48,000	25 in 8 in.
Chesapeake & Ohio.........	48,000	25 in 2 in.
Burlington & Missouri River	48,000	30 in 2 in.
Chicago, Burlington & Q...	49,000	28 in 8 in.
Lehigh Valley	50,000	30 in 4 in.
Missouri Pacific	47,000	26 in 8 in.
Mexican Central	48,000	25 in 8 in.
New York Central.........	48,000	28 in 8 in.
Norfolk & Western........	48,000	25 in 8 in.
Pennsylvania	48,000	25 in 8 in.
Philadelphia & Reading....	46,000	45 in 2 in.
Seaboard Air Line.........	48,000	25 in 8 in.
Southern	52,000	28 in 8 in.
Harriman associated lines..	52,000	28 in 8 in.

It is almost universal practice to specify 48,000 lbs. tensile strength, it being generally realized that an iron is thus secured which is strong, which will take a good head without hammering enough to strip the thread, and which will withstand the alternate bending.

A stay-bolt should be tested in a manner similar to which it is strained in service. Some years ago this matter was thoroughly agitated, and a large number of experiments were made with make shift apparatus. The results varied widely largely because of the different methods of holding the bolt, and because the bolts were vibrated in one plane. Very good results would be obtained if the bolt was vibrated in a plane parallel to the direction of piling, while very poor results would follow if it were vibrated at right angles thereto. A machine has been designed to record the number of vibrations of a given amplitude which a test-bar will withstand. It is especially adapted to the requirements of stay-bolt testing, and will hold stay-bolts from 3 in. to 8 in. long. The upper end is held rigidly while the lower end is given a circular vibratory motion, which can be adjusted from zero to a circle of ⅜-in. in diameter.

New Boiler Tube.

The accompanying illustration shows the Whitney corrugated boiler tube. The makers of this tube claim greater heating surface and a longer life than that of the ordinary straight tube; also freedom from live sparks and leaky ends. The hot gases are retained longer with this tube than with the straight tube on account of the rotating motion induced by the spiral form of the tube. The tube is naturally elastic, due to its spiral form, which relieves the strain on the flue sheets and prevents leakage at the flue ends. Tests made show that it will stretch ⅜ of an inch in 16 ft. before the elastic limit is exceeded. The fire-box end of the tube is drawn out for a distance of 8 in., and is made one to 1½ gages heavier than the body of the tube. This prolongs the life of the tube, inasmuch as the fire-box end of a tube is subjected to much severe service. The fire-box end of the tube is smaller in diameter than the other end. This increases the circulation around the fire-box flue sheet. These tubes have been tried for five years on a number of roads and they have given satisfaction. They are made by the New Jersey Tube Company, Newark, N. J.



The Whitney Spirally Corrugated Boiler Tube.

Ideal Car Service (Demurrage) Report.*

Notwithstanding the fifteen years' experience, there is still a great deal of diversity in the office methods and accounting of the Car Service Associations. In no respect is this greater, perhaps, than in the form of agents' daily car reports. Some require cars to be reported upon arrival and repeated, as each subsequent movement occurs, until the car is released. Others require cars to be reported upon arrival and not again until released. Still others (and the great majority) do not have any report made of the car until it is released, when the whole record is shown. Some managers have a report of all cars on hand once a week, some a report of all cars when they have been on hand six days, and others (the great majority) get no report, as stated before, until cars are released.

The thing most needed is an agent's daily car report, to include all cars on hand each

*Paper read before the National Association of Car Service Managers at Niagara Falls, June 16, by A. L. Gardner, of Baltimore.

day, and show the location of cars at the time the report is made; whether or not placed for unloading, and whether the delay is on the part of the railroad or consignee, and how much belongs to each. It is generally conceded that such a report is highly desirable; but it has not been adopted because of the objection raised by agents to the amount of labor involved in its preparation under the present system of entering all arrivals in the car service record book in date order. This objection can be overcome by abandoning the car service record book, and using as a substitute one carbon copy of the previous days' report, as described further on.

It should be remembered that upon arrival each car is entered in the book on the date it reaches destination. Then when the car reaches delivery track the original entry in the record book must be located, and the date and hour of placing the car entered in the proper column; and again when the car is released must this original entry in the book be found and date and hour of unloading entered. A third search in the book and entry in the "Ordered" column must be made for all cars that are held on arrival awaiting disposition of shipper or consignee. To prepare his daily report the agent must take the entries of cars released during the preceding 24 hours from the record book, turning the pages from entry of the oldest car released, until he has gone through the book to the latest arrivals, which involves the expenditure of more time in locating in the book the cars to be reported than in the actual making of the report.

In starting the new system the agent should make a complete inventory of all cars on hand at 6 p. m. on a given date. These cars should be entered on the daily report form in order of arrival, and complete data should be shown for every car in each column of the report, if released at that time; or, if not yet released, but in position for unloading, the entry will stop at "Placed" column; and if not yet placed, the entry will so state and in proper column will be shown "why not placed." This report should be made in duplicate, with indelible pencil, with the aid of carbon paper (two or more carbon copies may be made at the same writing, to be used as suggested below).

The carbon or duplicate copy of the preceding day's report becomes the basis for report of the next day. All changes of position of cars not yet unloaded, and the time of release of any that have been unloaded, should be noted on this carbon copy (instead of making entries in the book, as at present); thus when these changes have been noted, all that is necessary is to copy the amended form on a fresh sheet, and, after all entries have been taken from the old sheet, to enter the current day's arrivals, omitting, of course, all cars reported as released the preceding day.

The advantages of this system are:

First—The agent may have for his own information a complete inventory of all cars on hand, revised every 24 hours, and this without any cost in labor. Some stations may have such an inventory now, but if so, the labor of preparing it is in addition to that of making the car service reports. Were such an inventory made daily for the agent, he would have before him a record of each and every car on hand every day, and steps could be taken to hurry the placing or unloading, by calling attention of yardmaster to cars not placed; of Superintendent or Freight Claim Agent to cars on hand unclaimed or refused, and by duplicate notices (or telephone) to consignee of cars which in the judgment of the agent were being unduly delayed.

Second—That a second carbon copy may be made, without any cost in labor, and sent each day to the Division Superintendent for his information. From this copy he may know what cars are at each station on his division and whether in position and under charge for detention or not. Such a report would be a valuable addition to the information already received by Superintendents and would enable them to reduce the delay to cars on their division, particularly delay in placing for delivery.

Third—Such a method of reporting cars would assist inspectors in checking stations. Instead of comparing their list of cars noted on tracks they would refer to carbon copy of preceding day's business (amended as above), which is in more compact form. To illustrate: At one of our largest stations it takes the inspector two days to make a round of all the delivery tracks and sidings, list the cars he sees and note the condition of contents. To check this list against the agent's record book consumes three additional days, and then the inspector does not know that cars have been reported as entered in book. To determine this it is necessary to check the list in the Manager's office against the agent's reports. If the system advocated were adopted, but one checking would be necessary, and this could all be done by the inspector in about one-sixth of the time required by the present method.

Fourth—The Manager may receive each day a complete statement, for each station, of all cars on hand; and for those not yet released this report will show who they are for, whether placed on public or private track and if not in position for unloading whether the delay is on the part of the railroad or consignee. The desirability of having this information each day is obvious. In fact, it may be said that without such a statement, the manager is not in position to know that the rules are properly enforced by all interests alike.

Fifth—It is believed that the system proposed could be operated without any additional labor or expense in the agent's office, and that the work necessary to transfer cars on hand to the new sheets each day, is more than offset by the time consumed in finding cars in the record book for final entries and transfer to report. Instead of having cars on hand scattered over 50 or 100 pages of a record book, they would be confined to from 6 to 10 sheets even at the largest stations; and at most stations to a single sheet.

A prominent transportation official recently said that, "Now, more than formerly, officials in charge of operation are keeping in close touch with cars and car movements, as their handling is the most important factor in transportation." This doubtless has reference more particularly to the movement and handling of cars in transit, but I have yet to hear of any detailed system of locating and checking delay to cars standing under load at stations and terminals. The Car Service Association is usually only furnished with sufficient force to partially check the more important stations, and the Manager can (and doubtless most managers do) report a considerable number of the more aggravated cases of delay and inattention to the proper officer of the road interested; whereas, by the system herein proposed the Superintendent is furnished a report of every car under load at each station day after day, *while the delay is occurring*, and when the trouble can be noted and corrected. It has been truly said that "no system, however perfect, will run itself, and that the ablest and most trustworthy employee will perform better service if his work is carefully and regularly checked."

The latest word from high official quarters seems to be to the effect that the Car Service Associations should not be satisfied with getting cars released within the free time, but that their aim should be to secure their release as much inside of the limit as possible. Of course, no one should be satisfied with anything short of the very best, but it should not be overlooked in this connection that consignees have been releasing their cars with an average of about one day and a quarter, and we hardly think this record can be much improved under present conditions, although, with increased terminal facilities and careful supervision of the details of operation, there is no doubt that the detention to cars, both by railroad and consignee, can be still further reduced.

The Sewall Automatic Lock Coupling.

The accompanying cut shows a pair of 1½ in. steam couplings of the Sewall type, with automatic locks, made by the Consolidated Car Heating Co., Albany, N. Y. These couplings are interchangeable with the smaller sizes, but where intended to couple with 1⅛

Sewall Automatic Lock Coupling.

in. couplings, gaskets are used having a somewhat reduced opening. The automatic lock prevents uncoupling or leakage of steam due to the rigidity of 1⅝ in. hose. These results are also obtained when but one of the couplers is fitted with the locking device. The locks do not interfere with the automatic uncoupling, in the event of the train parting. This device is also made in the form of a clamp lock which can be applied to old couplings.

Railroad Telegraph Superintendents.

The 23d annual convention of the Association of Railway Telegraph Superintendents met at Indianapolis, June 15, President Charles S. Rhoads (C. C. C. & St. L.) in the chair. Mr. Rhoads delivered a brief address congratulating the Association on the fact that it was more prosperous than ever before. Hon. J. W. Holzman, mayor of Indianapolis, welcomed the delegates to the city, and Mr. Charles Selden, superintendent of telegraph of the Baltimore & Ohio, responded. After the transaction of some routine business 12 new members were elected; also 3 associate members and 4 honorary.

At the afternoon session there was a paper on the "Telephone in Railway Service," by A. G. Francis, of Chicago, railroad agent of the Chicago Telephone Company. Among other subjects, Mr. Francis discussed the equipment of railroad signal towers. The discussion on the paper was participated in by almost every member present. It was shown that trains are moved successfully on telephonic train orders on many railroads, and up to the present time there is no record of an accident traceable to the use of the telephones. The subject of the paper was referred to a committee with instructions to bring it before the American Railway Association, looking to action permitting the movement of trains on telephonic orders. The committee appointed for this purpose consists of Messrs. Charles Selden, Baltimore; E. P. Griffith, New York, and J. H. Jacoby, South Bethlehem, Pa.

The next paper was by F. G. Sherman, of the Central of New Jersey, on "The Economic Use of the Commercial Telegraph by Holders of Telegraph Franks Issued on Account of a Railroad Contract." This paper

also was discussed at great length, and many abuses of the articles of contract were told of.

At the evening session the members listened to a paper by J. B. Taltavall, on "The Telegraph Operator in the Railroad Service," which was given in the *Railroad Gazette* last week. The discussion that followed showed that the working of the telegraph could be improved without increasing expense, and many superintendents of telegraph told how their respective roads had improved the worth of the individual operator.

Mr. William Kline, of Toledo, O. (L. S. & M. S.), explained a local telephone system operated by nine railroads in Toledo to facilitate the exchange of business between the different companies. He said that since its establishment the movement of traffic had been greatly expedited. Mr. Griffith (Erie), chairman of the Committee on Composite Circuits, read a report on the subject which named the railroads in the United States at present using composite circuits, and also the results attained in each case. The discussion was taken up by Messrs. Jacoby (L. V.), Rhoads (C. C. C. & St. L.), Selden (B. & O.), Van Etten (C. & E. I.), Millington (Michigan Central), Hope (Chicago, St. P., M. & O.), Weidman (Pere Marquette), Ryder (C. B. & Q.), Parsons (I. C.) and others. This discussion was kept up till 10:30 p. m.

On the second day Mr. M. J. O'Leary, of New York, secretary of the Telegraphers' Mutual Benefit Association, was given an opportunity to explain the good work accomplished by that organization in the interests of the telegraph profession. Many of those present were members, and assurances of hearty cooperation were given.

Papers were read on the "Typewriter in the Telegraph Service," by L. S. Wells (Long Island), and on "Recent Improvements in Wireless Telegraphy," by William Maver, Jr. Mr. Rhoads, chairman of the Committee on Cipher Code, reported that the American Railway Association had ordered printed an elaborate cipher code that could be utilized in the transaction of business by all departments of railroad service.

Chattanooga, Tenn., was selected as the place of meeting next year, the date being fixed for May 17. H. C. Hope (C., St. P., M. & O.), St. Paul, Minn., was elected president, and E. E. Torrey (Mobile & Ohio), vice-president; and P. W. Drew (Wisconsin Central), Milwaukee, Wis., was re-elected secretary-treasurer.

The entertainments provided for the members included trolley rides around the city, an excursion on the Belt Line railroad dinner at the Columbia Club, and a trip to St. Louis, over the "Big Four."

EXHIBITS:

J. H. Bunnell Company, New York.—A full line of telegraph apparatus, including the Leech combination resonator and stand, the Ghegan automatic repeater, a new type of star zinc and hanger and a new straight-line tapping clamp.

C. P. Chenault, of Frankfort, Ky.—Sound magnifier for relays, the invention of Mat Hacker, of Irvine Ky.

An Adams-Randall composite circuit set was shown in full operation; the object of this device is to increase the initial energy of telephone currents to suit conditions.

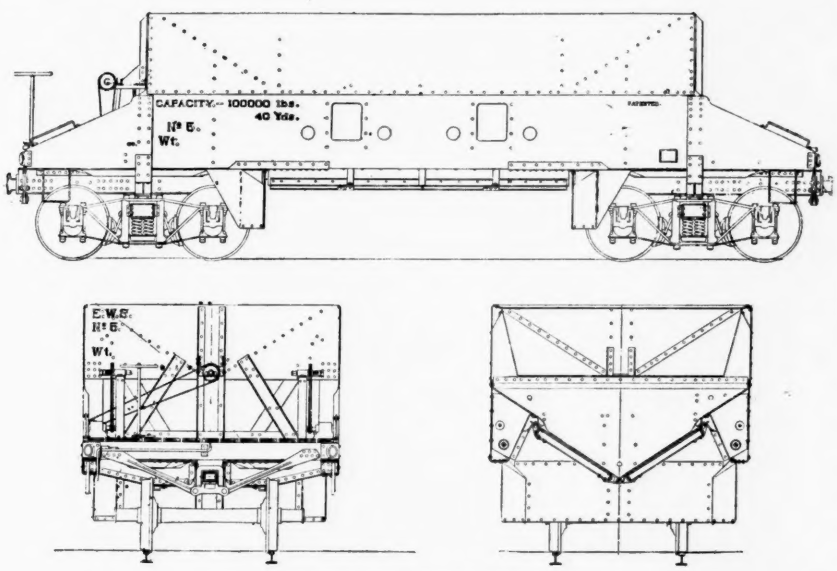
C. K. Jones, Quincy, Ill.—Automatic telegraph circuit protector and signaling machine. This apparatus was described in the *Railroad Gazette* of July 3, 1903, p. 499, and Mar. 4, 1904, p. 158.

Safety Insulated Wire and Cable Company, New York.—Insulated wire.

G. M. Dodge, Valparaiso, Ind.—Automatic telegraph sender, a device which transmits Horse characters for learners.

The Summers Gravity Dump Car.

The illustrations herewith show a gravity dump car invented by Mr. E. W. Summers, Pittsburg, Pa. The design is not a convertible car, but the load can be dumped either



The Summers Gravity Dump Car.

between the rails or on both sides of the track. The operator discharges the load and closes the door from the operating platform at the end of the car without stopping the train. The doors do not extend beyond the clearance limits, and all material is discharged clear of the track. The floor of the car from truck to truck is formed by a single pair of doors, which form a V-shaped bottom. These doors are hinged on both edges so that they serve as a floor in the car and as a chute bottom for conveying the load in either direction. Any material that can be handled with a steam shovel will pass through the door openings at either side of car or in the center, the large openings permitting a quick discharge of the load. The doors are controlled and lowered by means of worm gearing, which enables the operator to distribute ballasting material in the quantity desired, the doors standing in any intermediate position between closed and full open. The sides of the car are deep and a large top flange area is provided to take care of the compression due to a vertical load. The lower part of the sides is heavy box section and the cross beams are deep. Each door is supported on four ⅝ in. coil chains. The chains and shafting are protected from the lading by the double web floor-beams, the doors only being exposed. The car has a capacity of 100,000 lbs. and a cubic capacity of 40 sq. yds. A number of these cars are being built by the Pressed Steel Car Company.

Demurrage Managers' Convention.

The sixteenth annual meeting of the National Association of Car Service Managers was held at Niagara Falls, June 16 and 17, the president, J. C. Loomis, of Louisville, Ky., in the chair. There was a large attendance, representing nearly all of the 40 Car Service Associations of the country. After roll call, the meeting was addressed by Mr. C. Peter Clark, Vice-President and General Manager of the Buffalo & Susquehanna, and a member of the Car Service Committee of the American Railway Association. Mr. Clark spoke on car service matters in general, and referred particularly to the difficulties encountered in distinguishing between a railroad proper and an industrial railroad.

The President's address contained some recommendations relative to uniform reports and statements to auditors, and after discussion it was resolved that a standing committee be appointed to consider the whole subject of office methods and accounting, and report at the next meeting. The committee on demurrage clause in bills of lading reported progress. No definite communication has been received from the Car Service Committee of the American Railway Association, to which this matter was referred.

The committee on uniform rules reported a set of Car Service Rules, which could be recommended as rules for universal adoption by Car Service Associations wherever the local conditions were such that they could be applied, and these rules as reported by the committee were adopted by the Association. The motion to refer this set of rules to the American Railway Association was defeated, it being the sense of the majority of the members present that owing to legislation in various states, and the promulgation of car service rules by railroad commissions, it would be impracticable at this time to recommend a uniform set of rules that could be adopted or carried out in all sections.

The much mooted error rule (each railroad company shall pay car service accruing by reason of its errors) was withdrawn by the committee, but it was subjected to considerable discussion; and a resolution was passed to appoint a committee of three to refer this question to the Car Service Committee of the American Railway Association. This committee consists of W. M. Prall, J. C. Haskell and A. G. Thomason.

A paper was read by Mr. W. M. Prall, Commissioner of the Pittsburg Car Service Association, entitled "Per-diem: as applied by Car Service Associations in their Industrial Rule." The discussion elicited by this paper was to the effect that in the minds of the members, car service and per diem are essentially different in principle, and intended to serve different purposes, and should be kept separate in their application; and it was Resolved, That the tendency which has become manifest in some quarters to substitute per-diem for car service is fraught with danger to the integrity of car service rules, and should be resisted with all our power whenever and wherever it occurs.

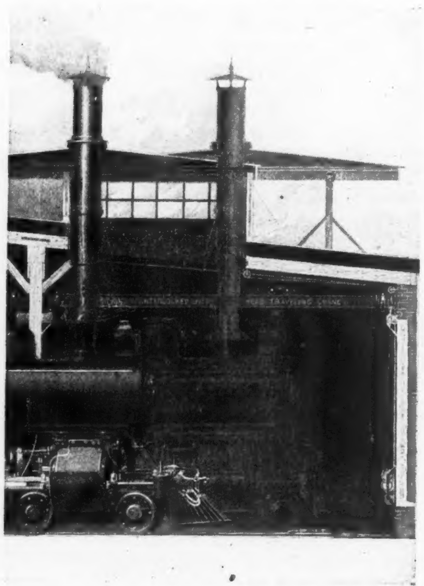
Mr. Gardner, of Baltimore, read a paper entitled "An Ideal Car Service Report," which will be found in another column. There was no discussion of this paper, the

members desiring to see it in print, and to give it careful study and consideration at home before expressing an opinion upon it.

Ashley J. Elliott, Manager of the Illinois & Iowa Car Service Association, Peoria, Ill., was elected President for the ensuing year, and Charles B. Peck, Manager of the Texas Car Service Association, Vice-President. A. G. Thomason, Scranton Pa., was re-elected Secretary and Treasurer. Washington, D. C., was selected as the place for the next annual meeting, which is to be held some time between May 3 and 15, 1905.

Improvements in Roundhouse Design.

Roundhouse design, although considerably advanced in recent years, is still lacking in a number of respects, one of which is a satisfactory solution of the smoke-jack problem. The old fixed jack, requiring the locomotive to be set exactly on a particular spot to bring its stack directly under the center of the jack, was improved by schemes permitting more flexibility, such as swinging jacks, elongated hoods, etc. The accompanying engraving shows a more flexible arrangement than any heretofore devised. It consists essentially of a monitor having the section of roof over the pit lengthened and made movable. This section contains the jack, which may therefore have a range of movement parallel to the engine pit of almost any desired amount, but which in practice is made from 4 ft. to 12 ft. The movable section has secured to its under side two inverted T rails, weighing, ordinarily, 30 lbs. to the yard, which run on four sheaves in the top of the monitor frame. Movement may be accomplished either by means of a lever extending downward to within reach of the floor, or by chains passing over pulleys to a drum on the side of the wall. This arrangement not only avoids the need of "spotting" the locomotive under the jack, either when first entering the house or when wanting to get up steam, but also permits movement back and forth as may be required in connection with repairs made on the locomotive while hot.



Movable Roundhouse Monitor.

The illustration also shows a traveling crane. While the need and desirability of cranes in roundhouses has come to be thoroughly appreciated, their use has generally been regarded as impractical because of conflict with the smoke-jacks. This design ingeniously overcomes the difficulty by providing a multi-telescoping jack, operated by chains from a graduated drum affixed to the wall of the house. To prevent damage to the jacks through carelessness or accident, an interlocking device is provided which prevents the crane from moving up to a jack that is down, or the jack from being lowered if the crane is in the way.

The movable jacks may be applied to any roundhouse having a monitor, or on the roof of which a monitor or supporting framework for the movable roof can be built. The adoption of the traveling crane is, of course, dependent on the roof construction of the roundhouse. The scheme was devised and the appliances made by Paul Dickinson, Chicago.

Lecture on Train Order Forms.*

The theory upon which the Standard Code rules is based is that the same order which takes away precedence from a superior train, also, and at the same time, confers right upon inferior trains.

Orders not in proper form or so worded that they are ambiguous, or which admit of different interpretations, must not be accepted, unless with the understanding that they are to be treated only as holding orders until proper orders are issued in their stead.

The word "meet" has but one simple meaning. Trains ordered to meet must go to the place of meeting, but not beyond, and must without fail wait at such place for the trains which they are instructed to meet, even though it be at the end of single track and the entrance to double track.

Trains must be positively identified; and each engineman, fireman, conductor and brakeman should assist in the identification of their train by giving its number to trains interested. The despatcher must, when necessary, add engine numbers; this is a good means of identification, unless there are duplicate numbers. Extras identify themselves when their engines can be seen. It must not be assumed that because there is a train on a siding, the engine of which is displaying a certain kind of signals, it is the train that is to be met or waited for; the true fact must be known. If in doubt about an approaching train, stop it.

Identification must sometimes be established by circumstantial evidence. If a regular train were waiting only for No. 1 and a passenger train looking like it passes on its time, displaying markers, and without green signals on the front of the engine, it may be concluded to be No. 1. If it were a passenger extra, white signals would be displayed on the front of the engine and, ordinarily, a meeting point would have been fixed with such extra, or it would have to stop to ascertain what regular train it was meeting.

To run freight trains as sections of first-class trains, especially as the first section, is confusing, and should not be done when possible to avoid it; or, if done, trains interested should be advised, or at least those likely to mistake the freight thus running as a first-class train, for some second-class train which they hold orders to meet, or to which they may be superior. Ordinarily, a train register is depended upon to indicate whether trains which are superior by right or class have arrived. When a train is made inferior to helpers, work-trains, water-trains, etc., which make several trips during a day, care should be exercised to know that such trains of superior right are met on the trip on which the order directs them to be met. Train-registering tickets (Form 56, Appendix) may in such cases be used to advantage, stating that the extra has arrived on the trip as indicated in a certain numbered order; and they are also useful when trains turn back from points where there are no train registers.

The rules do not require that the direction of extra trains be stated, except when necessary; but very little is gained by omitting the information at any time, and it would be better to habitually indicate the direction in which they are moving whenever they are mentioned.

Briefly stated, the seven governing principles relating to the movement of trains under train orders are:

First.—Meet does not mean anything but *meet*, even at the end of double track. A train is not met until the markers arrive, and until met, the waiting train may pass the meeting point only after receiving notice of the annulment of such opposing train; or after such train becomes 12 hours late; or after the order to meet is annulled; or after a new time-table takes effect while waiting, showing that there is no such opposing train; or after an order is received against such train, in which the words, "instead of" appear, thus superseding the "meeting" order.

Second.—Regular trains must be positively identified by their numbers, except as previously explained; and extra trains by their engine numbers.

Third.—Orders are in effect until fulfilled, superseded or annulled. One order does not supersede another unless the words "instead of" be added. When an order has been superseded it must not again be used. A part of an order may be either superseded or annulled, or one order may sometimes qualify another. Operators must never place on file an order addressed to a train.

Fourth.—Extra trains lose right when the last-named station mentioned in their "running orders" is reached, and they must pull into the siding at such station. Regular trains, and their sections, receiving train orders to run only to an intermediate station, lose their precedence upon their arrival at such station, and they must there pull into the siding. Every order held by such extra or regular trains becomes void upon their arrival at the last-named station to which they are directed to run, and must not again be used. Orders held by work-extras become void when the working order expires. Orders are fulfilled when trains running under them arrive at the district terminal. Helpers lose all their authority to run when they detach themselves from the train they are helping, unless they hold separate orders; and all orders held by them, while running as a part of the train which they are helping, become void when they separate from the train.

Fifth.—Time-orders make trains inferior only within the time-limits named, and the same orders confer right upon other trains to which such orders are addressed, while within such time-limits, but not beyond.

Sixth.—Trains may be created at initial stations by a clearance-card or by train orders addressed to them, but at other stations they can only be created by train-order and not by a message or a clearance-card. When a schedule is given a train, by clearance-card or otherwise, it retains its schedule between the points designated, or, in the absence of designation as to limits, to the end of its run on the district, unless such schedule is taken away from it by train order.

Seventh.—Orders not in proper form and which are not clear, if accepted, must be understood to have no further effect than as holding orders, in accordance with Rule 106 in such cases.

*From a forthcoming book on Rights of Trains on Single Track, by H. W. Forman, to be published by the *Railroad Gazette*.

GENERAL NEWS SECTION

THE SCRAP HEAP.

The U. S. Department of Agriculture has established in the Bureau of Chemistry a division to be known as the Division of Tests. The work of this division will be to test and investigate road materials and all materials of construction relating to agriculture.

The eastbound North Coast Limited express of the Northern Pacific was stopped by robbers on the night of June 16, near Bear Mouth, Mont., and the express car was blown open with dynamite. One of the safes was opened and its contents taken, but the officers of the company say that the value of the booty was small.

A man was arrested at Tunkhannock, Pa., last Monday, on suspicion of being a conspirator to wreck trains, the police having connected him with a letter which had been sent to President Mellen, of the New York, New Haven & Hartford, telling of a plot which had been made to wreck a train on which Mr. Mellen expected to travel to Chicago, and offering to thwart it for a price.

An order has been given for a radical reduction of forces, or of working time, or both, in the general offices of the Pennsylvania Railroad at Philadelphia. The reduction is expected to go into effect on the first of July, and the offices likely to be most affected are those of the auditor, the comptroller and the treasurer; the car record office and the passenger and freight departments.

A law which was passed in Alabama in February, 1903, conferring additional powers on the State Railroad Commission is to be tested in the courts, the Nashville, Chattanooga & St. Louis having decided not to comply with an order of the Commission requiring the removal of the station at Wyeth City. A similar order, issued by the Commission before the passage of the law referred to, was annulled by the Supreme Court.

Of the new railroad companies organized in the State of Arkansas in the month of May, thirteen, representing 304 miles of road, are companies owning lumber railroads, which are not to build any new tracks, but are organized as common carriers for the purpose of participating in through freight rates on shipments going to distant places, without incurring the charge of violating the spirit of the Interstate Commerce Law as laid down recently by the Interstate Commerce Commission.

Mr. Paul Morton, Second Vice-President of the Atchison, Topeka & Santa Fe, has been invited by President Roosevelt to become Secretary of the Navy. Washington despatches indicate that Mr. Morton is not likely to accept the position. Mr. Morton is 47 years old and is a son of the late J. Sterling Morton, of Nebraska, who was Secretary of Agriculture in the second cabinet of President Cleveland. He has only recently announced his affiliation with the Republican party, having formerly been a Gold Democrat.

The Lockport Power Canal.

At a meeting of the directors of the Niagara-Lockport & Power Co., on June 18, it was voted to increase the capital stock to $10,000,000. The work now in progress will be continued on the power canal between Niagara and Lockport and a permanent survey will be made for the canal route and the excavation plans. J. C. Robin, Lockport, N. Y., and P. D. Brady and R. E. Drake, Syracuse, N. Y., are directors.

Automobile Record, Boston to New York.

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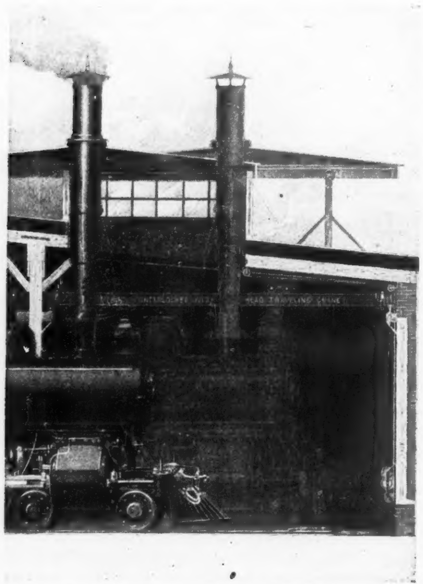
members desiring to see it in print, and to give it careful study and consideration at home before expressing an opinion upon it.

Ashley J. Elliott, Manager of the Illinois & Iowa Car Service Association, Peoria, Ill., was elected President for the ensuing year, and Charles B. Peck, Manager of the Texas Car Service Association, Vice-President. A G. Thomason, Scranton Pa., was re-elected Secretary and Treasurer. Washington, D. C., was selected as the place for the next annual meeting, which is to be held some time between May 3 and 15, 1905.

Improvements in Roundhouse Design.

Roundhouse design, although considerably advanced in recent years, is still lacking in a number of respects, one of which is a satisfactory solution of the smoke-jack problem. The old fixed jack, requiring the locomotive to be set exactly on a particular spot to bring its stack directly under the center of the jack, was improved by schemes permitting more flexibility, such as swinging jacks, elongated hoods, etc. The accompanying engraving shows a more flexible arrangement than any heretofore devised. It consists essentially of a monitor having the section of roof over the pit lengthened and made movable. This section contains the jack, which may therefore have a range of movement parallel to the engine pit of almost any desired amount, but which in practice is made from 4 ft. to 12 ft. The movable section has secured to its under side two inverted T rails, weighing, ordinarily, 30 lbs. to the yard, which run on four sheaves in the top of the monitor frame. Movement may be accomplished either by means of a lever extending downward to within reach of the floor, or by chains passing over pulleys to a drum on the side of the wall. This arrangement not only avoids the need of "spotting" the locomotive under the jack, either when first entering the house or when wanting to get up steam, but also permits movement back and forth as may be required in connection with repairs made on the locomotive while hot.



Movable Roundhouse Monitor.

The illustration also shows a traveling crane. While the need and desirability of cranes in roundhouses has come to be thoroughly appreciated, their use has generally been regarded as impractical because of conflict with the smoke-jacks. This design ingeniously overcomes the difficulty by providing a multi-telescoping jack, operated by chains from a graduated drum affixed to the wall of the house. To prevent damage to the jacks through carelessness or accident, an interlocking device is provided which prevents the crane from moving up to a jack that is down, or the jack from being lowered if the crane is in the way.

The movable jacks may be applied to any roundhouse having a monitor, or on the roof of which a monitor or supporting framework for the movable roof can be built. The adoption of the traveling crane is, of course, dependent on the roof construction of the roundhouse. The scheme was devised and the appliances made by Paul Dickinson, Chicago.

Lecture on Train Order Forms.*

The theory upon which the Standard Code rules is based is that the same order which takes away precedence from a superior train, also, and at the same time, confers right upon inferior trains.

Orders not in proper form or so worded that they are ambiguous, or which admit of different interpretations, must not be accepted, unless with the understanding that they are to be treated only as holding orders until proper orders are issued in their stead.

The word "meet" has but one simple meaning. Trains ordered to meet must go to the place of meeting, but not beyond, and must without fail wait at such place for the trains which they are instructed to meet, even though it be at the end of single track and the entrance to double track.

Trains must be positively identified; and each engineman, fireman, conductor and brakeman should assist in the identification of their train by giving its number to trains interested. The despatcher must, when necessary, add engine numbers; this is a good means of identification, unless there are duplicate numbers. Extras identify themselves when their engines can be seen. It must not be assumed that because there is a train on a siding, the engine of which is displaying a certain kind of signals, it is the train that is to be met or waited for; the true fact must be known. If in doubt about an approaching train, stop it.

Identification must sometimes be established by circumstantial evidence. If a regular train were waiting only for No. 1 and a passenger train looking like it passes on its time, displaying markers, and without green signals on the front of the engine, it may be concluded to be No. 1. If it were a passenger extra, white signals would be displayed on the front of the engine and, ordinarily, a meeting point would have been fixed with such extra, or it would have to stop to ascertain what regular train it was meeting.

To run freight trains as sections of first-class trains, especially as the first section, is confusing, and should not be done when possible to avoid it; or, if done, trains interested should be advised, or at least those likely to mistake the freight thus running as a first-class train, for some second-class train which they hold orders to meet, or to which they may be superior. Ordinarily, a train register is depended upon to indicate whether trains which are superior by right or class have arrived. When a train is made inferior to helpers, work-trains, water-trains, etc., which make several trips during a day, care should be exercised to know that such trains of superior right are met on the trip on which the order directs them to be met. Train-registering tickets (Form 56, Appendix) may in such cases be used to advantage, stating that the extra has arrived on the trip as indicated in a certain numbered order; and they are also useful when trains turn back from points where there are no train registers.

The rules do not require that the direction of extra trains be stated, except when necessary; but very little is gained by omitting the information at any time, and it would be better to habitually indicate the direction in which they are moving whenever they are mentioned.

Briefly stated, the seven governing principles relating to the movement of trains under train orders are:

First.—Meet does not mean anything but *meet*, even at the end of double track. A train is not met until the markers arrive, and until met, the waiting train may pass the meeting point only after receiving notice of the annulment of such opposing train; or after such train becomes 12 hours late; or after the order to meet is annulled; or after a new time-table takes effect while waiting, showing that there is no such opposing train; or after an order is received against such train, in which the words, "instead of" appear, thus superseding the "meeting" order.

Second.—Regular trains must be positively identified by their numbers, except as previously explained; and extra trains by their engine numbers.

Third.—Orders are in effect until fulfilled, superseded or annulled. One order does not supersede another unless the words "instead of" be added. When an order has been superseded it must not again be used. A part of an order may be either superseded or annulled, or one order may sometimes qualify another. Operators must never place on file an order addressed to a train.

Fourth.—Extra trains lose right when the last-named station mentioned in their "running orders" is reached, and they must pull into the siding at such station. Regular trains, and their sections, receiving train orders to run only to an intermediate station, lose their precedence upon their arrival at such station, and they must there pull into the siding. Every order held by such extra or regular trains becomes void upon their arrival at the last-named station to which they are directed to run, and must not again be used. Orders held by work-extras become void when the working order expires. Orders are fulfilled when trains running under them arrive at the district terminal. Helpers lose all their authority to run when they detach themselves from the train they are helping, unless they hold separate orders; and all orders held by them, while running as a part of the train which they are helping, become void when they separate from the train.

Fifth.—Time-orders make trains inferior only within the time-limits named, and the same orders confer right upon other trains to which such orders are addressed, while within such time-limits, but not beyond.

Sixth.—Trains may be created at initial stations by a clearance-card or by train orders addressed to them, but at other stations they can only be created by train-order and not by a message or a clearance-card. When a schedule is given a train, by clearance-card or otherwise, it retains its schedule between the points designated, or, in the absence of designation as to limits, to the end of its run on the district, unless such schedule is taken away from it by train order.

Seventh.—Orders not in proper form and which are not clear, if accepted, must be understood to have no further effect than as holding orders, in accordance with Rule 106 in such cases.

*From a forthcoming book on Rights of Trains on Single Track, by H. W. Forman, to be published by the *Railroad Gazette*.

GENERAL NEWS SECTION

THE SCRAP HEAP.

The U. S. Department of Agriculture has established in the Bureau of Chemistry a division to be known as the Division of Tests. The work of this division will be to test and investigate road materials and all materials of construction relating to agriculture.

The eastbound North Coast Limited express of the Northern Pacific was stopped by robbers on the night of June 16, near Bear Mouth, Mont., and the express car was blown open with dynamite. One of the safes was opened and its contents taken, but the officers of the company say that the value of the booty was small.

A man was arrested at Tunkhannock, Pa., last Monday, on suspicion of being a conspirator to wreck trains, the police having connected him with a letter which had been sent to President Mellen, of the New York, New Haven & Hartford, telling of a plot which had been made to wreck a train on which Mr. Mellen expected to travel to Chicago, and offering to thwart it for a price.

An order has been given for a radical reduction of forces, or of working time, or both, in the general offices of the Pennsylvania Railroad at Philadelphia. The reduction is expected to go into effect on the first of July, and the offices likely to be most affected are those of the auditor, the comptroller and the treasurer; the car record office and the passenger and freight departments.

A law which was passed in Alabama in February, 1903, conferring additional powers on the State Railroad Commission is to be tested in the courts, the Nashville, Chattanooga & St. Louis having decided not to comply with an order of the Commission requiring the removal of the station at Wyeth City. A similar order, issued by the Commission before the passage of the law referred to, was annulled by the Supreme Court.

Of the new railroad companies organized in the State of Arkansas in the month of May, thirteen, representing 304 miles of road, are companies owning lumber railroads, which are not to build any new tracks, but are organized as common carriers for the purpose of participating in through freight rates on shipments going to distant places, without incurring the charge of violating the spirit of the Interstate Commerce Law as laid down recently by the Interstate Commerce Commission.

Mr. Paul Morton, Second Vice-President of the Atchison, Topeka & Santa Fe, has been invited by President Roosevelt to become Secretary of the Navy. Washington despatches indicate that Mr. Morton is not likely to accept the position. Mr. Morton is 47 years old and is a son of the late J. Sterling Morton, of Nebraska, who was Secretary of Agriculture in the second cabinet of President Cleveland. He has only recently announced his affiliation with the Republican party, having formerly been a Gold Democrat.

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arrangement, a signal cleared by the signalman is virtually a clear block signal, and as a manual stop signal must be heeded for an indefinite length of time, a caution card is provided; and this is used in substantially the same manner as at telegraph block signal stations when a signal or a telegraph line is out of order. Towermen, in relieving one another, have to sign a statement on the train sheet, and the man going off duty must see that the fire buckets, lamps, and hand signals are in proper condition. All switches, locks, signals, and other devices, must be tested every morning, and a record of the inspection made. When a repairman disconnects a movement he must note the fact on the train sheet in the cabin, and sign his name.

An example of the minuteness with which some of the rules are drawn may be found in the following: "Repairmen shall adjust switches and movable point frogs with a standard switch gage, and if the gage of the track is incorrect, or the stock rail is improperly bent ahead of the points so that they do not face up properly, he shall notify the section foreman in writing, and if the necessary change is not promptly made, he shall notify the signal engineer. In the meantime the points must be adjusted to fit the stock rails as they are, so that there may be no possible chance of a wheel taking the wrong side of a point. If by any chance the gage should be so defective as to render such adjustment impossible, the repairman shall disconnect the signal for any diverging movement over that switch. He shall also make record of the occurrence on the block report, in accordance with Rule 595, and shall notify the assistant superintendent and signal engineer by wire. He shall also follow up the case and see that regular working is restored as promptly as possible."

"Trains stopped for an automatic or other permissive block signal" may proceed at once. On heavy up grades where it would be impossible to start, the full stop need not be made, speed being reduced to three miles an hour. In dwarf signals the night stop indication is given by a purple light.

Reasonable Rate on Peaches.

The Interstate Commerce Commission in an opinion by Commissioner Fifer, has announced its decision in the case of the Georgia Peach Growers' Association against the Atlantic Coast Line and others. It is held that if fruit is damaged through negligence of the carrier the carrier can be required to respond in damages to the full amount of the injury sustained; defendants' regulation whereby the rate is increased in proportion to the valuation is unreasonable and unjust. An arbitrary charge of $80 per car imposed by the New York, New Haven & Hartford from New York to Boston on peaches, its haul being part of the through service between Georgia and destination, is unreasonable and $50 per car would be a reasonable charge. Upon all the facts and circumstances, including on the one hand the difficulties and liability to loss attending the production and shipment of peaches, and on the other hand the large percentage of cars loaded above the prescribed minimum weights for carloads for which excess no charge is made by the carriers, the exceptional character of the service which involves fast time and prompt delivery at destination, the carriage of a large amount of non-paying freight, return of cars without loads and many other conditions relating to the highly perishable nature of the traffic, the Commission holds that neither the minimum carload weight nor the transportation charge established by the defendants' engaged in the carriage of peaches in refrigerator cars from Georgia points to New York, based upon a rate of 81 cents from Atlanta to New York, is unreasonable or unjust.

Trackless Car Line in Prussia.

A "trackless railroad," which will be the first of its kind in Prussia, is now being built from Monnheim to Langenfeld, 2½ miles, with two short branches for freight purposes. A current of about 550 volts will be used, and the power will be conducted to and from the cars, which are provided with electromotors, by means of two rotary poles, placed on the top of the cars, and sliding blocks enabling the train to give way from 10 to 12 ft. The wiring will consist of two hard-copper wires, with hard-rubber insulators, carried by iron poles about 18 ft. above the middle of the road. The second pole serves to conduct back the current, as ordinarily done through the rails. When two trains pass, one will remain standing under the wires and disconnect its current until the other is clear. The trains will consist of an electric locomotive for drawing two or three cars, driven by two electric motors of from 25 to 40 horse-power, and will be furnished with the necessary illuminating apparatus and brakes. The freight cars have a capacity of about five tons. These cars will be coupled in such a manner that the wheels of the car following run alongside the rut of the forward one, thus making a wide rut and lessening the damage to the road on wet days. For the passenger service a motor omnibus, having a seating capacity of 16 and standing room for eight, is provided. In case of an increased passenger traffic a similar car will be added. Five or six double trips at the rate of eight to ten miles per hour will be made daily. For the accommodation of the workingmen, in the morning and evening, two labor trains consisting of motor car and one or two passenger cars will be added. Freight will be carried on week days only, as conditions may require, and during the intervals between passenger trains. The fare for the entire trip will be 6 cents. For carrying freight the charge will be $2.38 per carload of 10 tons.—*Consular Report.*

German High-Speed Steam Locomotive Tests.*

Repeated reference has been made to the interesting tests made with specially constructed steam locomotives in order to secure a basis for conclusive comparisons between steam and electricity for high-speed traffic over long distances. The question to be decided by these deliberate and carefully prepared trials was whether, with the existing conditions of climate, distances between large cities, grades, curves, and the present standard of track and bridge construction in Germany, the speed of express passenger trains could be safely and economically increased to 70 or 80 miles per hour, and, if so, whether steam or electricity would prove preferable as a motive power. The electric motor trials were completed during the autumn of last year, with the result that the two motor cars made speeds of 117.32 miles per hour—or nearly two miles per minute—without injury to the car or motor, without undue strain upon the track or discomfort to passengers upon a straight, nearly level track 14.5 miles long, of heavy and solid construction, with inside guard rails to minimize the effect of lateral motion at high velocities. But as the railroads of Germany have all the usual variations of grade and frequent curves of a radius of 520 yards, any such speed as 117 miles an hour was and must long remain outside the limits of actual practice.

The experiments with steam locomotives began about the end of February and were continued until about April 15. The tests included engines of four different types, each built by a different German firm. In order to make the conditions as nearly as possible those of actual service, the load consisted of six vestibule cars weighing about 30 tons each, one of which had been equipped with instruments to measure and record speed, oscillation, and the pull exerted by the engine at each part of the run. Each engine was first tested with the full train, then half of it was detached and another series of trials made with three cars only.

The first trials were those of a locomotive built by the Egestorf Machinery Company, at Hanover. It is of the same general model as the "Atlantic" type in the United States. This machine, with a train of six cars, attained an average speed of 68.97 miles per hour throughout the run, and with three cars a speed of 79.41 miles an hour.

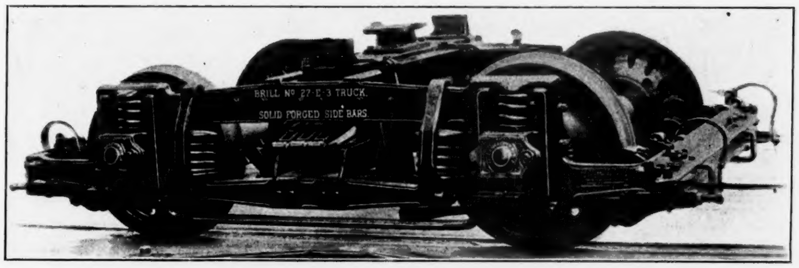
The second machine of Grafenstadt construction is a compound locomotive, likewise of the Atlantic type, in which the cylinders are placed far back and the piston head connected by a short connecting rod to the crank pin of the rear driving wheel. This engine made with the full train a run of 73.32 miles, and with three cars 76.42 miles an hour, and showed good results as to fuel and steam consumption.

The third contesting machine was an eight-wheel compound engine equipped with Schmidt's device for superheating steam. It was designed by Baurath Garbe and built by the well-known firm of A. Borsig, at Tegel, near Berlin. This engine was not built specially for these trials, but is one of a number of the same type which have been built by the same firm for the royal Prussian railroad administration. The driving wheels are 78 in. in diameter; heating surface, 963 sq. ft.; surface of superheater, 288 sq. ft. normal working pressure, 176.4 lbs., and weight in working order service, 120,051 lbs. This engine attained with the full train 79.53 miles an hour, and with three cars a speed of 84.5 miles an hour, the energy developed being about 2,000 h.p.

The fourth competitor was an engine of a wholly original type, designed by Chief Engineer Wittfeld, of the Prussian railroad administration, and built by Messrs. Henschel & Sons, of Cassel. Before being brought to Berlin it was tested on one of the State lines near Göttingen, and since the trials were finished it has been dismantled and shipped for exhibition at the World's Fair in St. Louis. Its most striking peculiarities are that the engineer stands in front within a glazed cab like the motorman of an electric car, and both engine and tender are covered with a sheathing of sheet iron with glazed windows and so arranged as to provide a covered passage from front to rear. The engine is carried on 12 wheels, viz., a four-wheel bogie in front and rear and between them the two pairs of drivers, coupled in the usual manner. The engine is the compound type, the high-pressure cylinder being midway between the side frames, where its piston connects with an inside crank on the forward driving shaft. The low-pressure cylinders, of which there are two of equal diameter, are external and drive two outside cranks set parallel to each other and on the same side of the axle 90 deg. from the inside crank that connects with the high-pressure cylinder. This secures an even balance between the reciprocating parts. The boiler is from the European standpoint, enormous, having 2,766 sq. ft. of heating surface, and it is calculated that, with a coal consumption of 2.5

*Abstracted from a report by United States Consul-General F. H. Mason, Berlin, Germany.

lbs. per horse-power hour, it will develop about 1,775 h.p. It weighs 76.8 tons and cost $23,800. The tender weighs 47 tons and carries seven tons of coal and 4,400 gallons of water, and has a water scoop. At the recent tests this engine slightly surpassed all its competitors, attaining a speed of 79.53 miles per hour with six cars and 85.12 miles with half that number. While, therefore, its



speed with the full train was the same as that of the Borsig superheater locomotive, the Cassel machine did 0.62 mile better with the light load, a difference so slight that it might easily have been influenced by varying conditions of wind.

The comparative advantages of all the contesting engines—their relative consumption of fuel and steam, their general efficiency at high velocities, and their smoothness of movement on curves of different radius—will be known only to the Government experts until the whole mass of notes and records made during the experiments and subsequently on other portions of the line shall have been formulated and published.

Among the incidental demonstrations made by the tests was the fact that with the pneumatic brakes now in use on German vestibule cars it required a full minute and a distance of 1,093 yards to stop a train of six cars running at 85 miles an hour. German first class trains are equipped for a maximum speed of 52.8 miles an hour, and their brakes are capable of stopping a train running at that speed on level track within a distance of about 433 yards. If, therefore, any approach to the higher speeds which will be made possible by these new types of locomotives should be adopted, the change will involve important modifications in brakes and signal systems, which are based on present limitations of speed and braking power.

Pending the preparation and issue of the official report on which the ultimate conclusions will be based, a Berlin engineer, Doctor Reichel, has given some interesting comparisons of cost between steam and electric traction from the standpoint of German practice and illustrated by the recent experiments with both motive forces. A steam train of five cars and a standard locomotive weighs 330 tons, seats 168 passengers, and uses at full speed 1,400 h.p. The electric train of one motor car and four trail cars weighs 260 tons, seats 180 passengers, and utilizes 1,000 h.p. Each train and engine costs for initial construction about $100,000. The operating cost of the steam train is fixed by Doctor Reichel at 12½ cents per 100 seat kilometers, and 11½ cents, or 1 cent cheaper, for the electric train.

Pennsylvania's New York Terminal Station.

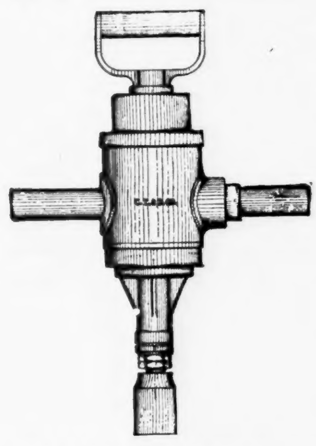
The New York Construction & Trucking Co., New York City, has secured the contract from the Pennsylvania Railroad to do the excavating for the site of its new terminal station in New York City, which was previously reported to another concern. The contract, it is said, is for $5,000,000, and the work is to be begun about July 1.

Remarkable Performances of an Interurban Type of Truck.

The No. 27-E type of truck built by the J. G. Brill Company, of Philadelphia, has recently had several opportunities to show its ability to stick to the rails under seemingly impossible conditions. Last week one of the heavy cars of the Wilkesbarre and Hazleton third-rail system, containing 85 passengers, while running at 60 miles an hour, struck two ties which some miscreants had secured to the rails, and although the pilot and some of the electrical apparatus was demolished, the car rode safely over the obstructions. It is doubtless due to the system of equalization of these trucks which brings the weight upon the frames close to the yokes, that the wheels safely returned to the rails after mounting over the ties at the high rate of speed at which they were running. A few weeks ago a car equipped with the same type of truck had a similar experience on a western road. A tie had been fastened over the rails, but the trucks rode safely over the obstruction although the car was running at 40 miles an hour. On the same road shortly after this occurrence, two cars mounted on this type of trucks met in head-on collision in a fog while running at full speed, yet the trucks of both cars held to the rails. One of the worse wrecks on interurban railroads in Ohio occurred early in June; two cars met in a head-on collision on a sharp curve and were nearly demolished, but the No. 27-E trucks on which both cars were mounted, remained on the rails.

An Electric Drill and a Pneumatic Hammer.

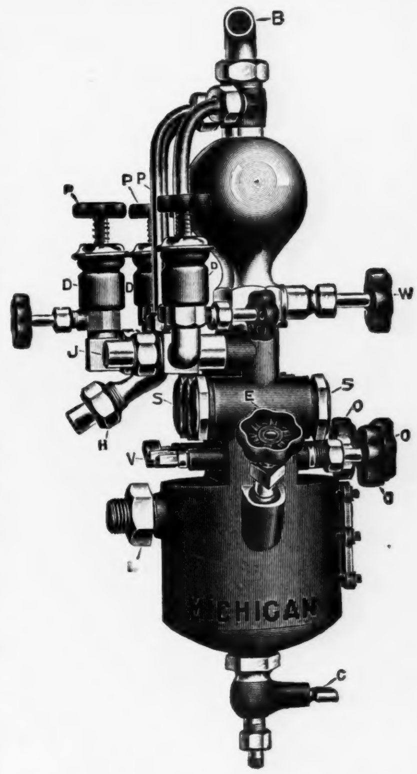
The Hayes electric drill shown in the accompanying illustration can be attached to any direct-current incandescent lamp socket of 110 or 220 volts. It has a capacity for drilling holes up to ⅜ in. in diameter. The drill spindle is central with the armature



shaft, and is driven by planetary gearing. A fan is mounted on the armature shaft, which forces a constant current of air through the motor casing, preventing overheating of the motor. The Green pneumatic hammer, made by the same company, has a plain piston type valve similar to a locomotive piston valve, placed vertically in the handle at the rear of the cylinder. The throttle valve is parallel to the main valve, and is directly behind it, allowing a direct flow of air through both valves to the cylinder. The position of the main valve does away with any valve block or casing, and permits the hammer to be taken apart without removing the handle. The hammer is built in all sizes. These two devices are made and sold by the Chicago Tool & Supply Company, Chicago.

The Michigan Bulls-Eye Lubricator.

The Michigan Lubricator Company, Detroit, has made application for a patent on a new bulls-eye locomotive lubricator, an illustration of which is shown herewith. One of the chief advantages claimed for it is the separation of condenser and body, permitting



a new condenser to be supplied by the maker, instead of having to replace both body and condenser. The oil is fed from the top of the reservoir into the sight-feed glass, there being a corded passage to each feed. Each separate feed has a drilled passage to the tallow pipes. The placing of the bulls-eye sight-feed glasses above the reservoir gives light on both sides, enabling the oil drops to be seen more readily. These glasses can be readily removed and cleaned without disturbing the packing or the sight-feed nipple. An observation glass in the front of the lubricator enables the oil in the reservoir to be seen at all times. Other advantages claimed for this lubricator are that there are no cast or cored passages inside of it except the water tube; impossibility of cross-feeding; impossibility of siphoning of water from the bulls-eye glasses in reversing the engine; absolute uniformity of feed, there being no racing or slowing up of the feed by partially or wholly closing the throttle of the engine. The oil being taken from the top of the lubricator, sediment will not feed into the oil nipples, but will drop to the bottom and be blown out when the lubricator is drained. The lubricator is guaranteed to

work with boiler pressures up to 225 lbs. It is furnished with auxiliary oilers, which permit of lubrication should the oil be dirty and clog the sight-feed glasses.

Manufacturing and Business.

The B. F. Sturtevant Company announces that it has removed its entire plant from Jamaica Plain to the new works at Hyde Park, Mass.

A new company is being formed at Muskogee, Ind. T., with a capital of $100,000 to build works to make bridge iron and other structural material.

The Sonora railroad stations at Nogales, Ariz., together with a number of freight cars and other buildings, was recently destroyed by fire; loss $100,000.

Samuel F. Warren has been appointed General Superintendent of the Pennsylvania Malleable Company, Pittsburg, Pa., succeeding Louis Knapp, resigned.

The Choska Bridge Company, of Muskogee, has been incorporated in Indian Territory, with a capital of $60,000, by W. J. Criswell, A. A. Kinney and S. H. Criswell.

W. D. Alexander, for four years with the Pennsylvania Malleable Company, has been appointed Superintendent of the Central Car Wheel Company at McKees Rocks, Pa.

The Memphis Land & Bridge Company, of Nashville, has been incorporated in Tennessee with a capital of $100,000 by F. M. Avery, W. R. Johnston, J. L. Norton and others.

The American Concrete Steel Bridge Co., of Portland, has been incorporated in Maine with a capital of $150,000. M. W. Baldwin is President and W. A. Castner, Treasurer, both of Portland.

Land has been bought by Morris & Lewis at Rock Island, Ill., as a site for a foundry and machine shop, for which contracts have been let, to cost about $25,000. The firm will make brake-shoes.

The Secor Engine Company, of Waterford, N. Y., has been incorporated with a capital of $500,000, to make engines, by H. A. Shipman, J. F. Lambias and G. Isaksen, of New York City.

The Syracuse Bridge Company, of Syracuse, has been incorporated in New York with a capital of $30,000, by A. H. Mallery, O. M. Wood, of Syracuse, and G. E. Sickman, of Newark Valley, N. Y.

The Jacobs Car Co., Chicago, was erroneously reported in these columns two weeks ago to be considering a proposition of the Commercial Club of Paris, Ill., offering it inducements to build shops at that point.

H. M. Marshall, formerly Assistant Superintendent of the Armour Car Lines, Chicago, will, after July 1, be Mechanical Superintendent of the shops of Templeton, Kenly & Co., Ltd., of Chicago, Ill., makers of Simplex jacks.

The South Atlantic Car & Manufacturing Co., of Waycross, Ga., at a recent meeting, increased its capital stock from $100,000 to $125,000. The company has been in operation about ten months and its profits during that time were $69,591.

Announcement is made of the resignation of Wayne Cunningham as Resident Engineer, of the Link-Belt Engineering Co., at Savannah. Mr. Cunningham will go into business for himself in the capacity of Consulting Engineer and Contractor.

The Pennsylvania Metallic Packing Company, of Camden, has been incorporated in New Jersey with a capital of $30,000 to make metallic and other kinds of packing. The incorporators are D. H. Stewart, H. P. Dowler and A. C. Read.

The Parsons Machinery Co., of Marlboro, has been incorporated in Massachusetts with a capital of $200,000. Henry Parsons is President and Treasurer, and Chester H. Parsons, Vice-President, both of Marlboro.

The Williams Engineering & Construction Company, of New York, has been incorporated with a capital of $12,000 to do a general contracting business. The directors are John Williams, J. F. Kennedy and J. H. Holmes, all of New York.

Bids will be received until July 18 at the U. S. Engineer office, 3232 Prytania street, New Orleans, La., for dredging a channel through Sabine Lake, Tex., as advertised in the *Railroad Gazette*. Information may be obtained from H. M. Adams, Lieut. Col. Engineers.

The Ingersoll Milling Machine Co., Rockford, Ill., has just moved into a new erecting shop, 65 ft. x 200 ft. The tract on which the shop is located contains 25 acres and is on the Chicago, Milwaukee & St. Paul Railroad. This concern makes heavy milling machinery.

The National Bridge Works, of Jersey City, has been incorporated in New Jersey with a capital of $70,000 to do general bridge work. The incorporators are Robert Giles and John Ginnans, of New York City; Thomas J. Foster, of Ridgewood, N. J., and Elliott E. Smith, of Englewood, N. J.

During the first four months of 1904 the Storrs Mica Company, Owego, N. Y., sold 50 per cent. more "Never Break" mica headlight chimneys and lantern globes than during the same period last year. The use of mica makes a large saving in the cost of chimneys and saves cleaning and replating of reflectors.

The Q. & C. Bonzano Rail Joint Company, Ltd., of Canada, has been formed in Montreal to make rail joints in Canada. The company intends to build a foundry. The officers of the company are: President, Norman J. Holden, of Montreal; Vice-President, Edgar M. Smith, of New York; Secretary-Treasurer, Charles F. Quincy, of Chicago.

The property of the Morse Iron Works & Dry Dock Co. at the foot of Fifty-fifth street, South Brooklyn, N. Y., was bought at auction June 16 by John F. Cadigan for $50,000 over the mortgages which aggregate $510,000. The purchase was made in the interest of the mortgagees, who will reorganize and continue the business under a new name.

S. Pearson & Son, of New York, has been incorporated with a capital of $1,000,000. This new company is the American branch of Pearson & Son, Ltd., of London. It has been formed to carry out the contract to build the Pennsylvania tunnel across New York City. The directors are E. W. Moir, of London, and George W. Wyckersham, Henry W. Taft, John F. Charlton and Arthur C. Patterson, of New York City.

Mr. T. T. Lyman, of the H. W. Johns-Manville Company, was the recipient last week of a beautiful silver loving cup, from his fellow members in the New York League of Heat & Cold Insulation. Mr. Lyman is the Chairman of the Executive Committee of the League, and the presentation was made at a dinner given in his honor at the rooms of the Building Trades Employers' Association on the evening of the 16th.

The Liberty Headlight & Lantern Company, Rochester, N. Y., incorporated as a reorganization of the Red Star Company, of that city, reports an increased business since Jan. 1 for headlights, lanterns, etc. W. H. Foulkes, President and Treasurer of the old company, is also President of the new company.

The General Railway Signal Company, of Buffalo, N. Y., recently formed by the consolidation of the Taylor Signal Company, of Buffalo, and the Pneumatic Railway Signal Company, of Rochester, has elected the following officers: Chairman of the Board, John M. Beckley; President, W. W. Salmon; First Vice-President, Fred Cooke, Rochester; Second Vice-President and Treasurer, George D. Morgan, Buffalo; Third Vice-President, M. Smyth, Rochester; Secretary, C. H. Littell, Buffalo.

The Chicago Pneumatic Tool Company reports business on the increase, May having shown the largest business of any month for some time. June promises to be even better. The company has received an order through President Duntley, who is in London, for 275 pneumatic appliances of different kinds, 50 of them being rock drills for Johannesburg, South Africa. Orders have also been received for 25 air compressors for European concerns, nine large D. S. C. compressors for the Pennsylvania R. R. and 35 railroad speed recorders for Germany.

Iron and Steel.

The Pennsylvania Steel Company, it is reported, has a contract from the Southern Pacific Company for 20,000 tons of rails, to be delivered at Galveston.

The Sloss-Sheffield Steel and Iron Company, it is said, sold 1,500 tons of pig iron for export last week. Prices are now on a basis in Great Britain which renders it possible for Southern producers to sell in that market. Several thousand tons of Alabama iron are reported to have been sold for export, the prices obtained for gray forge being $8.40 per ton and for No. 4 $8.75.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies see advertising page 30.)

American Society for Testing Materials.

The seventh annual meeting was held in Atlantic City June 16, 17 and 18. About 150 members attended. The society now has 500 members. The following officers were re-elected: President, Charles B. Dudley; Vice-President, R. W. Lesley; Secretary-Treasurer, Edgar Marburg, of the University of Pennsylvania, Philadelphia; member of executive committee, James Christie.

The American Association of General Baggage Agents.

The American Association of General Baggage Agents at its annual meeting held in St. Louis, June 8, elected the following officers: President, G. T. Spilman (C. G. W.), Chicago; Vice-President, Charles J. Wiggin; Secretary and Treasurer, J. E. Quick (G. T. R.) Montreal. The next meeting of the association will be held in Chicago, June 14, 1905.

International Engineering Congress.

At the international meeting of engineers to be held at St. Louis, Mo., October 3 to 8, under the auspices of the American Society of Civil Engineers, among the papers to be read will be the following:

Traffic on Improved Waterways, Etc.—Edward P. North, M. Am. Soc. C. E., New York City.

Railroad Terminals.—Elmer L. Corthell, M. Am. Soc. C. E., New York City; W. T. Foxlee, M. Inst. C. E., London, England; Ernest Pontzen, Cor. M. Am. Soc. C. E., Ingénieur des Constructions civiles, France.

Underground Railways.—William Barclay Parsons, M. Am. Soc. C. E., Chief Engr., Rapid Transit Comm., New York City; Basil Mott, M. Inst. C. E., and David Hay, M. Inst. C. E., Central London and City and South London Railways, England; M. Biette, Ingénieur des Ponts et Chaussées, adjoint à

l'Ingénieur en Chef du Chemin de fer Métropolitain de Paris, France.

Locomotives and Other Rolling Stock.—William Forsyth, M. Am. Soc. M. E., Chicago, Ill.; G. J. Churchward, M. Inst. C. E., Chief Locomotive Supt., Great Western Ry., England; Edouard Sauvage, Ingénieur en Chef des Mines, Professeur á l'Ecole des Mines, France.

Live Loads for Railroad Bridges.—Henry W. Hodge, M. Am. Soc. C. E., New York City.

The Substitution of Electricity for Steam as a Motive Power.—James G. White, M. Am. Soc. C. E., New York City; Alexander Siemens, M. Inst. C. E., London England.

Ventilation of Tunnels.—Charles S. Churchill, M. Am. Soc. C. E., Chief Engr., Norfolk & Western R. R., Roanoke, Va.; Francis Fox, M. Inst. C. E., London, England.

Concrete and Concrete Steel—Edwin Thacher, M. Am. Soc. C. E., New York City; John S. Sewall, Capt., Corps of Engrs., U. S. A.; Fr. von Emperger, Vienna, Austria; Armand Considère, Inspecteur Général des Ponts et Chaussées, France.

Deep Foundations.—John F. O'Rourke, M. Am. Soc. C. E., New York City; W. F. Druyvesteyn, Engr., Royal Corps of Waterstaat, Groningen, The Netherlands; Louis Coiseau, Vice-Pres. de la Société des Ingénieurs Civils de France, Enterpreneur de Travaux Publics, France.

The Manufacture of Steel.—William Metcalf, Past-Pres., Am. Soc. C. E., Pittsburg, Pa., and Chas. B. Dudley, M. Am. Soc. C. E., Altoona, Pa.

Tests of Materials of Construction.—E. L. Candlot, Ingénieur Civil, France. Steel—William R. Webster, M. Am. Soc. C. E., Philadelphia, Pa.; L. L. Baclé, Ingénieur Civil, France. Timber—Gaetano Lanza, M. Am. Soc. M. E., Boston, Mass. Cement—William A. Aiken, M. Am. Soc. C. E., Pittsburg, Pa.

Steam Turbines.—Francis Hodgkinson, M. Am. Soc. M. E., Pittsburg, Pa.; M. Rateau, Ingénieur des Mines, Professor à l'Ecole des Mines, France.

Electrical Power—Generating Stations and Transmission.—L. B. Stillwell, M. Am. Soc. C. E., New York City.

Engineering Education.—Robert Fletcher, Assoc. Am. Soc. C. E., Prof. of Civil Engineering, Dartmouth Coll., Hanover, N. H.; Calvin M. Woodward, Dean of Eng. School, Washington Univ., St. Louis, Mo.; W. Cawthorne Unwin, F. R. S., M. Inst. C. E., Cooper's Hill College and City and Guilds Technical College, London, England.

The Manufacture of Cement.—Robert W. Lesley, Assoc. Am. Soc. C. E., Philadelphia, Pa.

PERSONAL.

—Mr. C. H. Chappell, the former well known General Manager of the Chicago & Alton, died suddenly at his home in Chicago on Wednesday last, at the age of 63.

—Mr. Roy V. Wright, Mechanical Engineer of the Pittsburg & Lake Erie, is to become associate editor of the *American Engineer and Railway Journal.*

—Mr. E. H. Johnson, late Division Engineer at Elmira, N. Y., for the Erie Railroad, has formed a partnership with M. Del Papa, of Elmira and New York, to engage in a general and railroad contracting business.

—Mr. Robert Coit, of New London, Conn., died at his home in that city, on June 19, of heart disease. Mr. Coit had for many years been connected with the New London Northern Railroad (now a part of the Central Vermont) and was president of the company at the time of his death.

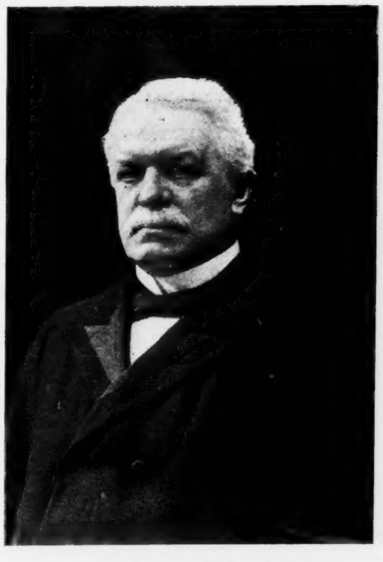
—Mr. John Gilbert Meiggs, a noted railroad builder, and brother of Henry Meiggs, of South American fame, died in London, June 20, at the age of 77. Mr. Meiggs was interested with his brother in the building of the Oroya railroad in Peru. He had lived in London for the past 30 years.

—Mr. L. L. Bentley, whose promotion to be Mechanical Engineer of the Lehigh Valley was recently announced, has been in railroad service 14 years. He is a graduate of Cornell University, and his first work was on the Baltimore & Ohio, where for six years he was an inspector in the test department. In 1897 he became a civilian inspector for the U. S. Navy, to inspect guns, armor plates and materials used in ship building. In 1902 he returned to railroading and entered the service of the Lehigh Valley as an inspector. Then he was successively foreman of the drawing room and chief draftsman, which latter position he held until his recent promotion as above.

—Mr. J. H. Fildes, the new Master Mechanic of the Lehigh Valley at Buffalo, N. Y., has been in railroad service since 1873. He began in the shops of the Lake Shore & Michigan Southern as machinist apprentice at Elkhart, Ind., and took a course in Mechanical Drawing in the evenings. In 1879 he went to Terre Haute as a machinist and gang foreman for the Vandalia Line, and seven years later went to the Chicago &

Western as General Foreman. Then for a short time he was on the Chicago & Eastern Illinois, and in 1896, left the railroad service to go to Indianapolis, where he was Superintendent of the Hetherington & Benner Machine & Foundry Company, which company he left in 1900, to go to South Easton, Pa., as General Foreman on the Lehigh Valley. He was promoted to be Master Mechanic at Weatherly, Pa., in 1902, and in the early part of this month was made Master Mechanic at Buffalo.

—The accompanying portrait is that of the late Mr. F. Wolcott Jackson, Resident Manager of the Pennsylvania Railroad lines in New Jersey, whose death was announced in our issue of June 17. Mr. Jackson was born at Newark, N. J., in 1833, and had been in active railroad service for about 49 years.



He was a graduate of Yale University and in the early fifties was in the mercantile business in New York and Liverpool. In 1855 he began his railroad career as Secretary for the old New Jersey Railroad & Transportation Company, of which company his father was Vice-President and General Manager. In 1867 he was made General Superintendent. When the Pennsylvania came into control, four years later, his jurisdiction was extended over the Camden & Amboy and the Philadelphia & Trenton railroads, which with the New Jersey Railroad & Transportation Company made up the United Railroads of New Jersey. This position he held until 1899, when he was appointed to the position he held at the time of his death. Mr. Jackson was also President of the United New Jersey Railroad & Canal Company; the Associates of the Jersey Company; Camden & Burlington County, and also President and Director of several other lines leased by the Pennsylvania in New Jersey. Mr. Jackson was also an elder in the South Park Presbyterian Church of Newark, N. J.; a trustee of Princeton Theological Seminary; trustee of the American Bible Society; a member of the Union League of New York; a Director in the New Jersey Historical Society; Treasurer of the German Theological School of Bloomfield, N. J.; and was also connected with other religious and secular societies. Mr. Jackson is survived by his wife, six sons, Philip Nye Jackson, John B. Jackson, United States Minister to Greece; William F. Jackson, Rev. Frederick W. Jackson, Jr.; Charles H. Jackson and Oliver W. Jackson, and three daughters, Elizabeth Wolcott Jackson, Mrs. Neilson Abeel, and Martha N. Jackson.

—The late A. C. Hutchinson, of New Orleans, who was President of Morgan's Louisiana & Texas and other Southern Pacific lines in Louisiana and Texas, and who died in December, 1902, left cash and property amounting to about $800,000 to be given to Tulane University, of New Orleans.

ELECTIONS AND APPOINTMENTS.

Canadian Pacific.—W. K. Thompson has been appointed Division Superintendent, with headquarters at White River, Ont., succeeding G. Erickson, who has been appointed Superintendent at Cranbrook, B. C., succeeding J. G. Taylor.

Chicago, Rock Island & Pacific.—G. P. Johnson has been appointed Superintendent of Car Service, with office at Chicago, succeeding C. H. Cannon, resigned.

Delaware & Hudson.—E. W. Porter has been appointed Auditor of railroad department accounts, with office at Albany, N. Y.

Illinois Central.—J. M. Daly is now in charge of the Car Accounting Department, with the title of Car Accountant; office at Chicago.

Interoceanic of Mexico.—S. W. DeWolf has been appointed Division Superintendent of the Mexico Division, and H. A. McCulloch Division Superintendent of the Gulf Division.

Louisville & Atlantic.—A. C. Hone, General Manager, has resigned.

Mexican Central.—H. Putnam has been appointed Assistant to the General Manager, with headquarters at Mexico, succeeding Thos. Mason.

Pittsburg & Lake Erie.—Wilbur P. Richardson has been appointed Mechanical Engineer, with headquarters at Pittsburg, Pa., succeeding Roy V. Wright, resigned, effective July 1.

St. Louis, Brownsville & Mexico.—The officers of this company are: President, Uriah Lott; Vice-President and Treasurer, R. J. Kleberg; Second Vice-President and General Manager, Jeff N. Miller, and Secretary, H. W. Adams.

San Pedro, Los Angeles & Salt Lake.—H. M. McCartney, Assistant Engineer, has resigned.

Union Pacific.—Arthur H. Fetters has been appointed Mechanical Engineer, with head-

quarters at Omaha, Neb. Cubitt B. Smyth has been appointed Assistant Mechanical Engineer, to succeed Mr. Fetters.

LOCOMOTIVE BUILDING.

The Guatemala Central is having one locomotive built at the Baldwin Locomotive Works.

The Ohio & Kentucky is having two locomotives built at the Pittsburg Works of the American Locomotive Co.

The Norfolk & Western, as reported in our issue of June 17, has ordered seven simple Consolidation (2-8-0) locomotives from the American Locomotive Co. These locomotives will weigh 175,100 lbs., with 157,850 lbs. on drivers; cylinders, 21 in. x 30 in.; diameter of drivers, 56 in.; radial stayed boiler, with a working steam pressure of 200 lbs.; 213 iron tubes, 2¼ in. in diameter and 14 ft. 6 in. long; fire-box, 9 ft. 4½ in. long and 5 ft. 4¼ in. wide; tank capacity, 6,000 gallons of water, and coal capacity, 10 tons. The special equipment includes: Westinghouse brakes, cast-iron brake-shoes, Monitor injectors, U. S. piston-rod and valve-rod packings, Ashton safety valves, Leach sanding devices, Nathan sight-feed lubricators, Railway Steel-Spring Co.'s springs, Latrobe driving-wheel and truck-wheel tires, cast-steel wheel centers and Norfolk & Western headlights and couplers.

The Gulf & Ship Island, as reported in our issue of June 10, has ordered two simple Atlantic (4-4-2) locomotives from the Baldwin Locomotive Works. These locomotives will weigh 130,000 lbs., with 76,000 lbs. on drivers; cylinders, 19 in. x 24 in.; diameter of drivers, 72 in.; straight boiler, with a working steam pressure of 180 lbs.; heating surface, 2,047.2 sq. ft.; 258 iron tubes 2 in. in diameter and 14 ft. 3 in. long; fire-box, 89⅝ in. long and 42 in. wide; grate area, 26.1 sq. ft.; tank capacity, 4,500 gallons of water. The special equipment includes: Westinghouse-American air-brakes, hammered steel axles, sectional Magnesia boiler lagging, Leeds reversible pilot couplers, U. S. 18-in. headlights, Monitor injectors, U. S. metallic piston-rod and valve-rod packings, Ashton safety valves, Leach sanding devices, Nathan triple sight-feed lubricators, cast-steel springs, Crosby steam gages and Midvale driving-wheel tires.

CAR BUILDING.

The Green Bay & Western is having 150 freights built by Haskell & Barker.

The Chesapeake & Ohio has ordered one flat car and four gondolas from the American Car & Foundry Co.

The Minneapolis & St. Louis has ordered 400 box cars of 60,000 lbs. capacity from the American Car & Foundry Co.

The Wisconsin & Michigan is about to build 100 standard flat cars of 60,000 lbs. capacity at its Peshtigo shops.

The Tehuantepec National is having 20 freight cars built at the St. Charles Works of the American Car & Foundry Co.

The Solvay Process Company, Syracuse, N. Y., is having 12 freight cars built at the McKees Rocks Works of the Pressed Steel Car Co.

The Canadian Pacific has ordered 50 ore cars of 60,000 lbs. capacity from the Standard Steel Car Co. These cars will be 24 ft. long, over end sills, 8 ft. 6 in. wide, over side stakes, and 8 ft. 6 in. high, from top of rail to top of body, to be built of steel, with steel underframes. The special equipment includes: Simplex bolsters, with Susemihl side bearings, Simplex brake-beams, Westinghouse air-brakes, Tower couplers, Miner tandem draft rigging, Harrison dust guards, McCord journal boxes and lids, Barber roller trucks and cast iron wheels.

The Southern, as reported in our issue of June 17, has ordered nine combination baggage and mail cars from the American Car & Foundry Co. These cars will be 61 ft. long over end sills and 60 ft. long inside measurement, 9 ft. 10⅛ in. wide over side sills and 14 ft. 7½ in. high over all. The special equipment includes: Diamond brake-beams, M. C. B. brake-shoes, brasses, couplers, draft rigging, journal boxes and journal-box lids, Westinghouse brakes, American Car & Foundry Co.'s platforms, Pintsch gas, straight steam-heating system, Buhoup short vestibules and Paige wheels.

BRIDGE BUILDING.

BOSTON, MASS.—At a recent meeting of the Cambridge Bridge Commission, Engineer Jackson was instructed to prepare plans for the Soldiers' Field bridge between Boston and Cambridge, to cost about $120,000; also to prepare plans for the Essex street bridge, which is to cost $117,000.

CLEVELAND, OHIO.—Bids are wanted July 6 by the Board of County Commissioners for building a steel bridge in Olmsted Falls village; also for a steel bridge in Orange Township. Julius C. Dorn is Clerk.

COLORADO SPRINGS, COLO.—The Denver & Rio Grande bridge and a number of others have been carried away by high water.

DEADWOOD, S. DAK.—Bids are wanted July 1 by E. H. Warren, County Auditor, for building three or more steel bridges in Lawrence County.

OREGON, ILL.—The Chicago, Burlington & Quincy, it is reported, will build a steel bridge 75 ft. long to replace the present structure over Rock River.

ELLISVILLE, MISS.—The County Supervisors have under consideration the question of building eight steel bridges in Jones County.

FOND DU LAC, WIS.—Bids are wanted July 6 by F. A. Bartlett, City Clerk, to remove the present bridge, remodel abutments and build a new bridge over the west branch of the Fond du Lac River at Seymour street.

FORMAN, N. DAK.—Bids are wanted July 11 by R. McCarten, County Auditor, for building a steel bridge in Hall Township.

HARRISBURG, PA.—Separate bids are wanted July 5 by J. M. Shumaker, Superintendent of Public Grounds and Buildings, for rebuilding the substructures and the superstructures of the following bridges: Over the Shenango River at Sharpsville, in Mercer County; over the Beaver River at Moravia, in Lawrence County; over the Lackawanna River at Blakely Borough, in Lackawanna County; over the north branch of the Susquehanna River at Danville, in Montour County; over the Lackawanna River at Acid Factory, in Wayne County; over the Lackawaxen River at Farnham, in Wayne County; over the same river at Goodman, in Wayne County, and over the north branch of the Susquehanna River at Ulster, in Bradford County.

KNOXVILLE, TENN.—The Southern Railway, it is reported, will rebuild many of its bridges on the Knoxville Division to permit the use of larger engines. There are about 15 bridges between Knoxville and Chattanooga which may be rebuilt.

LAWRENCE, MASS.—The Boston & Maine, it is reported, will build a steel bridge over the Annisquam River on its Gloucester branch.

LOS ANGELES, CAL.—Plans have been made for rebuilding the Los Angeles Railway via- on San Fernando street at a cost of about $25,000.

LYNN, MASS.—A bill has been signed by the Governor authorizing the Haverhill & Roxford to build a bridge over the Merrimac River.

NEW HAVEN, CONN.—All bids for the Kimberly avenue bridge have been rejected and City Engineer Kelley will receive new ones till June 27.

OCOTLAN, MEX.—It is reported that the Mexican Central will build an iron bridge to replace the present structure.

PEORIA, ILL.—Plans are being made by City Engineer Stebbins for the new steel bridge to be built over the Illinois River at Bridge street, which is to be 2,400 ft. long and cost about $150,000.

PORTLAND, ORE.—The City Council has passed a resolution to build steel bridges at Union avenue to cost $55,000, and at Grand avenue to cost $45,000.

RED BLUFF, CAL.—The Board of Supervisors has under consideration the question of building two bridges over the stream at the east end of the town at a cost of about $34,000.

RICHMOND, VA.—The joint committee of Richmond and Manchester have recommended the building of a bridge over the James River to cost about $250,000.

ROCHESTER, N. Y.—A special committee has been appointed by the Board of Supervisors to fix on a site for the new river bridge to cost $200,000.

SAN JOSE, CAL.—Residents are petitioning for the building of a bridge on San Antonio street.

SAN MIGUEL, MEX.—The St. Louis, Brownsville & Mexico and the National, it is reported, will jointly build a bridge over the Rio Grande.

SAVANNAH, MO.—Bids are wanted July 6 by J. E. Schnitzius, Bridge Commissioner, for building two steel bridges and some other bridge work in Andrew County.

TOLEDO, OHIO.—A contract has been awarded by the city for the substructure of the Fassett street bridge to Louis Montville at $7,007, and for the superstructure to Huston & Cleveland, agents of the American Bridge Co., at $27,989.

VINCENNES, IND.—A contract has been given to the Vincennes Bridge Co. by the County Commissioners at $14,765, to replace the bridges carried away by recent storms.

WESTPORT, CONN.—The New York, New Haven & Hartford is to build a new double-track steel bridge over the Saugatuck River. Daly & Holbrook, of Mt. Vernon, N. Y., have the contract for building the abutments and the trestle work, and the Scherzer Bridge Co. for the superstructure of the draw. The contract for the steel fixed spans has not yet been let.

Other Structures.

BATON ROUGE, LA.—An ordinance, it is reported, has been passed by the City Council authorizing the Yazoo & Mississippi Valley to build a new passenger station to cost about $30,000.

MERIDA, YUCATAN.—Plans have been submitted to the City Council by the Yucatan Railroads of Yucatan for the new passenger station to be built here.

MIDLAND, MICH.—The Pere Marquette, it is reported, has plans ready for building a new brick passenger station and office building to cost about $15,000.

ROCHESTER, N. Y.—The Buffalo, Rochester & Pittsburg, it is reported, has bought land, on which it will build a large fireproof office building.

ST. THOMAS, ONT.—The Pere Marquette, it is reported, has commenced work on its new shops here.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ARKANSAS ROADS.—A company has been organized in Arkansas to build a railroad from West Point through Kensett to Searcy, in White County, a distance of nine miles. H. G. Smith, W. H. Foster and others, of West Point, Ark., are interested.

ASHLAND & WESTERN.—Incorporation has been granted this company in Ohio to build

a railroad from Ashland southeast to Custaloga, 20 miles. C. P. Hine, R. A. Wilbur, C. L. Denton and others, of Ashland, Ohio, are incorporators.

BLACK HILLS & WYOMING.—Press reports state that location surveys have been completed for building this line from Rapid City, S. Dak., to Mystic, 35 miles. It is stated that grading will be begun at once. This company bought the Dakota, Wyoming & Missouri River in the early part of this year with the intention of finishing the line which the latter company had started to build between Rapid City and Mystic, of which only eight miles had then been completed. C. D. Crouch, Akron, Ohio, is President, and F. C. Tucker, Deadwood, S. Dak., is Chief Engineer. (See Construction Supplement.)

CAMPBELLFORD, LAKE ONTARIO & WESTERN.—An act has been passed by the Dominion Parliament authorizing this company to build a railroad from Blairton to Leaside Junction, Ont., via Campbellford and Whitby. Connection will be made at both ends with the Canadian Pacific. W. J. Crossen, Cobourg, Ont., is said to be interested.

COLORADO & NORTHWESTERN.—A contract has been awarded to Stott & Co. for grading the first eight miles of the twenty-mile branch from Sunset northwest to Eldora, Colo. Work will be begun at once and the remainder of the road will be built as soon as possible. R. S. Sumner, Boulder, Colo., is Chief Engineer. (June 3, p. 430.)

CONSOLIDATED RAILWAY (CONNECTICUT).—Work has been begun on extending the Fairhaven & Westville branch from Fairhaven to Wallingford, Conn. This link will give the Consolidated Railway a complete electric line between New Haven and Wallingford.

DALLAS & EASTERN TEXAS TRACTION.—Articles of incorporation have been filed by this company in Texas. It is proposed to build an electric railroad from Dallas east through Mesquite, Forney, Terrell and Elmo to Willspoint, 40 miles. The new line will parallel the Texas & Pacific between these points. T. L. Marsalis, Dallas, Tex.; R. S. Kimbrough, Mesquite, Tex., and others are incorporators.

FRANKLIN & PARKER'S LANDING.—A charter has been granted this company in Pennsylvania to build a railroad from Franklin, Pa., to Parker's Landing, in Armstrong County, 35 miles. The company is capitalized at $350,000 and is incorporated in the interests of the Pennsylvania Railroad for the purpose of providing a short parallel route for that portion of the Allegheny Valley Railroad which lies between the points mentioned.

GREAT NORTHERN.—An officer writes that work is now in progress on the following lines: Grand Forks, B. C., to Phœnix, 22 miles; Curlew, Wash., northwest to Midway, B. C., 14 miles, and a line five miles long to the Gramby smelter. All of the above work is under contract to Siens & Shields, St. Paul, Minn. Work is also in progress on a line from Thief River Falls northward for a distance of 30 miles. A. Guthrie & Co., St. Paul, Minn., have the contract for this line. (June 3, p. 430.)

HOXIE, STRAWBERRY RIVER VALLEY & WESTERN.—Press reports state that surveys have been completed for this proposed railroad from Hoxie, Ark., northwest through Lawrence, Sharp and Izard counties to Franklin, 50 miles. Grading will be begun as soon as the rights of way have been secured. R. S. Thomas, Hoxie, Ark., is President. (May 20, p. 392.)

INTER-CALIFORNIA (SOUTHERN PACIFIC.)—This company has been incorporated in California to build the proposed extension of the Southern Pacific from a connection with the Imperial branch to a point near Calexico on the boundary line between the United States and Lower California. (See Southern Pacific, June 17, p. 7.)

JERICO & SOUTHWESTERN.—According to newspaper reports, this company has been incorporated in Missouri to build a railroad from Jerico, Mo., southwest for a distance of 20 miles to a connection with the Missouri Pacific. L. C. Gates, Jerico, Mo., may be addressed.

LAKE TAHOE RAILROAD & TRANSPORTATION CO.—This company has recently been incorporated to build a railroad from Truckee to Lake Tahoe, 15 miles. Surveys are reported in progress. W. S. Bliss, Crocker Building, San Francisco, is Chief Engineer.

LOUISIANA CENTRAL.—An officer writes that grading has just been begun on this proposed railroad from Monroe, La., south to New Iberia, 180 miles. The work is being done by the Louisiana Construction Co. G. W. Decker, Newport, Ark., is President. (April 22, p. 314.)

LOUISVILLE & NASHVILLE.—An officer writes denying the report that this company is planning to build a line from West Pascagoula, Miss., through Vancleave and Augusta to Laurel.

MINNEAPOLIS, RED LAKE & MANITOBA.—Articles of incorporation have been filed by this company in Minnesota. It is proposed to build a railroad from Lower Red Lake, in Beltrami County, in a southeasterly direction to a connection with the Minnesota & International in the same county. C. A. Smith and others, of Minneapolis, are incorporators.

MOBILE, JACKSON & KANSAS CITY.—Press reports state that contracts have been awarded for track laying, bridging and grading on 143 miles of line from Newton to Pontotoc, Miss. The grading will be done by C. D. Smith & Co., Memphis, Tenn., and track laying and bridge work will be done by F. W. Johnston & Co., Newton, Miss. The contract for all the buildings along the line has been let to the Jarrett Construction Co., of Springfield, Mo. W. D. Stratton, Hanover Bank Building, New York, is President. (See Construction Supplement.)

MONROE CENTRAL.—Press reports state that a charter has been granted this company with power to build a railroad through Monroe and Greenbrier Counties, in West Virginia, from a point near Peterstown through Red Sulphur Springs and Union to Ronceverte, 75 miles. A branch line is also proposed in an easterly direction to Sweet Springs, 32 miles. E. C. Vincent, Union, W. Va., is Chief Engineer.

NASHVILLE, CHATTANOOGA & ST. LOUIS.—The extension of this road from Tracy City, Tenn., to Coalmont, six miles, has been completed and is now in operation. This new line will open up a large number of mines in the vicinity of Coalmont. (See Construction Supplement.)

NEW HOPE VALLEY.—A charter has been granted this company in North Carolina to build a railroad from a point in Chatham County to a point in the southern part of Orange County, 20 miles. William Moncure, Raleigh, N. C., and others are interested.

OKLAHOMA & CHEROKEE CENTRAL.—A charter has been granted this company in Oklahoma to build a railroad from a point near Adair, Ind. T., through the Cherokee and Osage reservations to Blackwell, Okla. T., 100 miles. Connection will be made with the Missouri, Kansas & Texas at Adair. G. M. Green, C. R. Havighorst and others, of Guthrie, Okla. T., are incorporators.

OPELOUSAS, GULF & NORTHEASTERN.—Surveys are now in progress on this proposed road from Opelousas, La., in a southeasterly direction to Moreauville, 35 miles, with a branch southwest to Crowley, 27 miles. Contracts for grading will be let as soon as surveys are completed, which will be in the near future. L. E. Littell, Opelousas, La., is Chief Engineer. (May 27, p. 410.)

SOUTHERN.—The directors of this company have ordered the construction of an extension from Jasper, Ind., to French Lick Springs, 26 miles. It is stated that work will be begun at once and that the new line will probably be open for traffic before January 1. (See Construction Supplement.)

TENNESSEE R. R.—A contract has been awarded to Eskridge & Carroll for building this road from Paint Rock Creek, Tenn., to the New River, 5½ miles. The line will eventually be built to Oneida, where connection will be made with the C., N. O. & T. P. Work has already been begun. J. D. Roberts, Harriman, Tenn., may be addressed. (May 6, p. 354.)

WICHITA FALLS & OKLAHOMA.—This company has opened its extension from Wichita Falls, Tex., to Byers, 23 miles, and the line is now in operation between Seymour and Byers, 75 miles. J. W. Field, Wichita Falls, Tex., is Chief Engineer. (May 6, p. 354.)

WINCHESTER & WASHINGTON (ELECTRIC).—This company has been organized in Virginia to build an electric railroad from Washington, Va., north to Winchester, 30 miles. S. L. Hoover, Winchester, Va., may be addressed.

RAILROAD CORPORATION NEWS.

CHICAGO, BURLINGTON & QUINCY.—Clark, Dodge & Co., of New York, and Lee Higginson & Co., of Boston, are offering $9,500,000 3½ per cent. first-mortgage Illinois Division bonds of the C., B. & Q. due in 1949. These bonds are the remainder of the authorized issue of $85,000,000 aside from the $28,173,000 reserved to retire the $24,024,500 prior lien bonds. They are the balance of the $15,492,000 recently purchased by the above firms, of which $5,992,000 were sold several weeks ago bearing 4 per cent. interest. The reason for the change in the rate of interest is due to the decision recently handed down by the Supreme Court of Massachusetts granting the directors the right to change the rate of interest on these bonds from 4 per cent. to 3½ per cent. (June 17, p. 8.)

CHICAGO, ROCK ISLAND & PACIFIC.—Announcement has been made that the First National Bank of New York City has bought $7,500,000 of 4½ per cent. notes of the Chicago, Rock Island & Pacific. These notes will run for three years and are secured by $11,250,000 first-mortgage and refunding 4 per cent. bonds. It is stated that J. P. Morgan & Co., Blair & Co. and Kidder, Peabody & Co. are associated with the First National Bank in the purchase of these notes. No official statement has been made with regard to the purposes of this note issue, but it is reported that the proceeds from the sale will be used for improvements made on one of the subsidiary lines of the C., R. I. & P.

COLUMBUS, MECHANICSBURG & WESTERN.—This company, formerly the Urbana, Mechanicsburg & Columbus Electric, has increased its capital stock from $100,000 to $2,000,000. Senator Foraker, of Ohio, is said to be largely interested in the road.

DENVER & SOUTHWESTERN.—At a meeting of the reorganization committee of this company held on June 20, it was announced that a number of holders of bonds (representing about one-half of the interests which had not assented to the original plan) had agreed to the amended plan recently made by this committee. Although no definite action was taken, it was announced that the property would probably be sold under foreclosure proceedings for the benefit of the assenting bondholders. For full particulars with regard to the plan, see our issue of May 27, p. 410.

INDIANAPOLIS SOUTHERN.—Despatches from Indianapolis say that this company has been acquired by the Illinois Central and will be merged with the Effingham Division which extends from Effingham, Ill., to Switz City, Ind., 86 miles. The Indianapolis Southern is now building from Indianapolis to Sullivan, Ind., 110 miles. Chief Engineer F. H. Hazelrigg, of the Indianapolis Southern, is quoted as saying: "Details are now being arranged so that the Illinois Central can enter Indianapolis. The Indianapolis Southern is to be reorganized and is to be merged with the Effingham Division of the Illinois Central. We expect to have through trains running by January 1 between In-

dianapolis, Memphis, New Orleans and other southern points."

LAKE & RIVER.—On the application of the Columbus Savings & Trust Company a receiver has been appointed for this road. Charles Esselburn has been named by the court. The Lake & River was formed in 1902 by the consolidation of the Ashland & Worcester and the Richmond & Mahoning Railroad Companies. The Columbus Savings & Trust Co. has a mortgage on the property of $350,000.

METROPOLITAN STREET RAILWAY (NEW YORK).—The report of this company for the quarter ending March 31 shows gross earnings of $3,262,844, as against $3,573,469 during the same period in 1903. Operating expenses during the three months increased $216,662, leaving a decrease in net earnings of $527,287. With regard to this falling off in both gross and net, President Vreeland says: "During the winter quarter, the unusual amount of snow and unfavorable weather not only reduced gross earnings, but very materially increased the operating expenses. In addition, about 60 per cent. more accident cases (principally for accidents which occurred over three years ago) were disposed of than during the corresponding period of the previous year. At the present time our operating expenses are down to the normal basis and the gross earnings of the system for April and May show a substantial increase over the corresponding period of last year."

MINNEAPOLIS & ST. LOUIS.—At a recent meeting of the directors of this company, it was voted to pass the dividend on the common stock. The stock has received dividends since 1900 and has been on a 5 per cent. basis during 1904. The amount of outstanding common stock is $6,000,000. The usual 5 per cent. dividend on the preferred stock, of which there is $5,000,000 outstanding, was declared on June 15.

NEW YORK CENTRAL & HUDSON RIVER.—It is stated that the New York Realty & Terminal Company, which was recently incorporated under the laws of New York State with a nominal capital of $100,000, has been formed for the purpose of acquiring real estate for the New York Central & Hudson River Railroad. The directors of the company include: W. K. Vanderbilt, William Rockefeller, S. F. Barger, J. P. Morgan, James Stillman, H. McK. Twombly and Chauncey M. Depew. No official statement has as yet been issued by the company.

NORFOLK & WESTERN.—At a meeting of the stockholders of this company on June 17, the proposal of the directors to issue bonds not exceeding $35,000,000 was approved. The bonds will run for 40 years and will bear interest at a rate not exceeding 4 per cent. They will be secured by a first lien on all extensions and branches which are now free from the lien of the first consolidated mortgage bonds. The vote on the bond issue was unanimous. The bonds will be designated as divisional and first lien bonds and will be a general mortgage. The Guarantee Trust Co. of New York has been named as trustee. The proceeds from the sale of the bonds will be used for the completion of double track, the building of new lines and for general improvements. (May 6, p. 354.)

NORTH SHORE.—It is reported that E. H. Harriman and associates have bought $1,500,000 of bonds of this company. The road runs from Sausalito, Cal., to Cazadero, 80 miles, and it is said to be the plan of Mr. Harriman to make this road a part of the Southern Pacific.

PITTSBURG, VIRGINIA & CHARLESTON.—A meeting of the stockholders of this company has been called for June 29 to vote on the proposition to purchase the franchises and property rights of the Monongahela & Washington R. R., 14¼ miles long. The entire capital stock, $550,000, of the latter company is owned by the Pennsylvania. A controlling interest in the Pittsburg, Virginia & Charleston is also owned by the Pennsylvania, so that the proposed transfer is a formality involving no essential change in ownership.

ST. LOUIS, SAN FRANCISCO & TEXAS.—The Attorney General has approved the amendment to the charter of this company increasing its capital stock from $200,000 to $3,000,000. The company is now in a position to take over the three other railroad properties authorized by an act of the last Texas Legislature. The roads which are to be merged are the Blackwell, Enid & Texas; the Oklahoma & Texas, and the Red River, Texas & Southern. (June 10, p. 450.)

SOUTHERN PACIFIC.—At a meeting of the directors of this company on June 15, a plan was approved for issuing $100,000,000 seven per cent. non-cumulative preferred stock. A meeting of the stockholders is called for a date early in July to pass on this proposal. According to the plans, $40,000,000 of the new stock will be issued at once and stockholders will be allowed to subscribe to the new issue at par to the extent of 20 per cent. of their holdings. The outstanding capital stock of the Southern Pacific is $197,849,227, of which amount $90,000,000 is owned by the Union Pacific. The total floating indebtedness of the Southern Pacific is about $30,000,000. A circular has been issued to the stockholders explaining the reasons for the new issue as follows: Large expenditures have been made in recent years for betterments and additions to existing lines for new equipment and the construction of wharves, docks, elevators and other improvements at Galveston. These expenditures were met chiefly from earnings and loans. In order to provide the capital necessary to discharge all floating debt, and for all additions and betterments authorized and contemplated during the next year, the issuance of preferred stock to the amount of $40,000,000 at this time is deemed expedient. The proceeds from the sale of this stock, in addition to providing for the needs above mentioned, will enable the company to refund bonded obligations maturing during the next three years, amounting to over $65,000,000, on a much more favorable basis of credit, and will leave over $30,000,000 of free and negotiable assets in the treasury.

TERRE HAUTE & INDIANAPOLIS.—The recent annual report of this company shows gross earnings on all lines operated of $5,124,299, an increase of $571,436. Operating expenses increased $729,178, leaving a decrease in net earnings of $157,742. The large increase in operating expenses was due largely to heavy expenditures for additions to equipment and betterment work on the T. H. & I. and the St. L., V. & T. H. The higher cost of locomotive fuel and of wages also helped to increase maintenance charges. After deducting all fixed charges, the surplus for the year was $335,419, a decrease of $111,041 over 1902.

TOLEDO RAILWAY & TERMINAL.—An official of this company has recently said that this road has not been sold to the syndicate which recently bought the Cincinnati, Hamilton & Dayton. A working agreement has been made however with the syndicate, and both the C. H. & D. and the Pere Marquette will in future have representatives on the Board of Directors of the Toledo Railway & Terminal Co.

WABASH-PITTSBURG TERMINAL.—This company has acquired the majority of the total capital stock of the Wheeling & Lake Erie. The total capitalization of the W. & L. E. is $20,000,000 of common stock, $5,000,000 of 4 per cent. non-cumulative first preferred stock and $12,000,000 of 4 per cent. non-cumulative second preferred stock. The company operates 470 miles of road between Toledo, Cleveland, Zanesville, Canton and Sherrodsville, besides controlling the Toledo Belt Line, the Cleveland Belt Line and other short branches.

EDITORIAL ANNOUNCEMENTS:

THE BRITISH AND EASTERN CONTINENTS edition of the Railroad Gazette is published each Friday at 35 Parliament street, London, S. W. It consists of most of the reading pages and all of the advertisement pages of the Railroad Gazette, together with additional British and foreign matter, and is issued under the name, Transport and Railroad Gazette.

CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

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RAILROAD GAZETTE

THE MANHATTAN BRIDGE.

Elsewhere in this issue is shown a collection of drawings to illustrate the principal engineering and architectural features of the new Manhattan bridge which is to span the East river, connecting New York and Brooklyn a short distance above the old Brooklyn bridge and considerably below the Williamsburgh bridge. Without consideration, for the moment, of its engineering features, the noteworthy thing about the Manhattan bridge is the very praiseworthy effort which has been to make of this great piece of engineering work an imposing monument. In the great cities of Europe it is almost taken as a matter of course that beauty and utility must exist together in municipal works, but here in America, perhaps to a greater degree in New York than in certain other parts of the country, we have always been overtaken by our necessities. We have met the demands of the crowding population with great promptness and we have solved many new problems as fast as they have arisen, but we have been so engaged in thus considering the fundamental requirements of the growth in population that we have perhaps not always stopped to consider that our great municipal works must nevertheless stand as monuments, either of beauty or of ugliness, for generations. The use of steel, particularly of steel piers, in great bridges, tends to violate the architectural principle that for beauty's sake there should be seemingly ample support for whatever is supported. The strength of steel is so great in proportion to its section area that the eye gets a sense of inadequacy in viewing a massive roadway supported by slender towers and threadlike cables. A glance at the Manhattan bridge drawings will show how the architects, Messrs. Carrere & Hastings, have considered this and placed corbels in those places where the eye naturally seeks to find some buttress or reinforcement of the slender supports. By the pains taken in this and in other matters to treat the bridge as a monument instead of merely a traffic necessity, it loses no beauty as an engineering work, but gains the grace and dignity which befit the municipal engineering works of the greatest American city.

RESPONSIBILITY FOR GRADE CROSSING ACCIDENTS.

It is perhaps unduly severe to say that Governor Odell, of the State of New York, is guilty of murder in any degree in the killing of Frank B. Read at Van Cortlandt Park on June 12; yet this and other frequent grade-crossing accidents were caused quite directly by him. So high-placed an officer should be presumed to have full knowledge of the fatal results of preventing the elimination of points where highways cross railroad tracks at grade. The records of years of killing and maiming at these points, increasing with increases of speed and density of traffic, were available to him, and during the years of his unfeeling opposition to this simple measure for saving life they have often been collected and presented to him in forms understandable by a most primitive mind. Nevertheless, he continues to veto the moderate appropriations needed for the fulfilment of a most beneficent law. And he kills people.

The Governor's point of view in the matter, if he has any, seems to be that grade-crossing removal is the sole concern of the railroad, and that State funds are needed for other purposes, such as escorting personally conducted parties to St. Louis. But the matter is fully covered by law, which takes into consideration the fact that many existing grade crossings date back through a long period of years to the time when the establishment of communication was the immediate necessity and the great congestion of population about large cities had scarcely begun. From the early desires of the commonwealth for means of transit and the absence of laws to the contrary, it is fair to say that the State of New York in early times assumed the responsibility for grade crossings, and it is obviously fair to suppose that some share at least of this responsibility still remains. Under the present laws if a new railroad crosses an existing highway, the expense of avoiding a grade crossing must be borne entirely by the railroad, and if a new highway is built crossing an existing railroad the expense is rightfully shared alike by the municipality which demands the highway and the railroad which by its location obstructs it. But where there are existing crossings—and they are shockingly numerous in the highly populated State of New York—half the expense of removal is to be borne by the railroad and the balance is divided equally between the municipality and the State. The cost to the railroad of grade-crossing removal, therefore, is twice as great as the cost to the State; yet, at the present time, the railroads in New York are most anxious to prosecute this work with zeal, and are provokingly delayed by the action of the State's chief officer, and by him alone.

The present grade-crossing law went into effect in 1897, prior to which the only crossings eliminated were those changed voluntarily by the railroad companies, or through mutual arrangements with the towns and municipalities. The law now provides for an annual appropriation by the Legislature out of any moneys not otherwise appropriated of $100,000, to pay the State's share of the expense of removing existing highway crossings from grade. That is to say, $400,000 a year is all that may be spent for this purpose, after the State's contribution has been swelled by the share borne by the railroads and the municipalities, respectively; but, if less than this is spent during any year, the balance, instead of going to the credit of the account, becomes part of the appropriation for the ensuing year, and does not increase it. Last year the Legislature appropriated sums for prosecuting the elimination of grade crossings generally throughout the State, and for two or three particular localities. The Governor vetoed all of these sums with the sole exception of $75,000 toward the total estimated cost of the State's appropriation of $275,000 for Schenectady.

This year the State Legislature appropriated the following sums:

(1) For general grade-crossing work still unexpended on sums appropriated two years ago, which, under the law, has to be re-appropriated, $74,893.

It is to be very much regretted that the Governor vetoed this appropriation, so that work which was started two years ago in good faith on sums then appropriated, has either to be discontinued or taken care of from the sum mentioned below in paragraph 3.

(2) For general grade-crossing work, not to be expended until next year and several years thereafter, so as to enable the Board of Railroad Commissioners to consider plans and approve them with the knowledge that money was available with which to do the work, $200,000.

This amount was vetoed by the Governor, so that the Railroad Commissioners are unable to consider and approve plans for which they have not the money in sight.

(3) For general grade-crossing work throughout the State, $150,000.

Out of this sum must come the $74,893 that remains unspent from the appropriation of two years ago, since the re-appropriation was vetoed by the Governor; and it must also provide for the further sum of about $25,000 for the expenditure of which the Railroad Commissioners are committed by previous action; so that there now remains available not over about $50,000 to be applied on work to be approved by the Railroad Commissioners, and this work may be still further decreased by cost in excess of estimates.

In other words, the great State of New York, with its 8,000 miles of railroad and 8,600 grade crossings, has less than $50,000 with which to continue the work of eliminating these crossings, to compare with the half million dollars appropriated annually by the State of Massachusetts for the same purpose. For the past two years the three parties in interest—the railroad company, the municipality, and the State, through its Legislature—have been willing and anxious to spend the money required to carry out grade-crossing elimination; yet, the will of these parties in interest is thwarted by the action of one man, who, for his own reasons, continues systematically to veto appropriations.

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The Board of Trade takes a decided stand

dianapolis, Memphis, New Orleans and other southern points."

LAKE & RIVER.—On the application of the Columbus Savings & Trust Company a receiver has been appointed for this road. Charles Esselburn has been named by the court. The Lake & River was formed in 1902 by the consolidation of the Ashland & Worcester and the Richmond & Mahoning Railroad Companies. The Columbus Savings & Trust Co. has a mortgage on the property of $350,000.

METROPOLITAN STREET RAILWAY (NEW YORK).—The report of this company for the quarter ending March 31 shows gross earnings of $3,262,844, as against $3,573,469 during the same period in 1903. Operating expenses during the three months increased $216,662, leaving a decrease in net earnings of $527,287. With regard to this falling off in both gross and net, President Vreeland says: "During the winter quarter, the unusual amount of snow and unfavorable weather not only reduced gross earnings, but very materially increased the operating expenses. In addition, about 60 per cent. more accident cases (principally for accidents which occurred over three years ago) were disposed of than during the corresponding period of the previous year. At the present time our operating expenses are down to the normal basis and the gross earnings of the system for April and May show a substantial increase over the corresponding period of last year."

MINNEAPOLIS & ST. LOUIS.—At a recent meeting of the directors of this company, it was voted to pass the dividend on the common stock. The stock has received dividends since 1900 and has been on a 5 per cent. basis during 1904. The amount of outstanding common stock is $6,000,000. The usual 5 per cent. dividend on the preferred stock, of which there is $5,000,000 outstanding, was declared on June 15.

NEW YORK CENTRAL & HUDSON RIVER.—It is stated that the New York Realty & Terminal Company, which was recently incorporated under the laws of New York State with a nominal capital of $100,000, has been formed for the purpose of acquiring real estate for the New York Central & Hudson River Railroad. The directors of the company include: W. K. Vanderbilt, William Rockefeller, S. F. Barger, J. P. Morgan, James Stillman, H. McK. Twombly and Chauncey M. Depew. No official statement has as yet been issued by the company.

NORFOLK & WESTERN.—At a meeting of the stockholders of this company on June 17, the proposal of the directors to issue bonds not exceeding $35,000,000 was approved. The bonds will run for 40 years and will bear interest at a rate not exceeding 4 per cent. They will be secured by a first lien on all extensions and branches which are now free from the lien of the first consolidated mortgage bonds. The vote on the bond issue was unanimous. The bonds will be designated as divisional and first lien bonds and will be a general mortgage. The Guarantee Trust Co. of New York has been named as trustee. The proceeds from the sale of the bonds will be used for the completion of double track, the building of new lines and for general improvements. (May 6, p. 354.)

NORTH SHORE.—It is reported that E. H. Harriman and associates have bought $1,500,000 of bonds of this company. The road runs from Sausalito, Cal., to Cazadero, 80 miles, and it is said to be the plan of Mr. Harriman to make this road a part of the Southern Pacific.

PITTSBURG, VIRGINIA & CHARLESTON.—A meeting of the stockholders of this company has been called for June 29 to vote on the proposition to purchase the franchises and property rights of the Monongahela & Washington R. R., 14¼ miles long. The entire capital stock, $550,000, of the latter company is owned by the Pennsylvania. A controlling interest in the Pittsburg, Virginia & Charleston is also owned by the Pennsylvania, so that the proposed transfer is a formality involving no essential change in ownership.

ST. LOUIS, SAN FRANCISCO & TEXAS.—The Attorney General has approved the amendment to the charter of this company increasing its capital stock from $200,000 to $3,000,000. The company is now in a position to take over the three other railroad properties authorized by an act of the last Texas Legislature. The roads which are to be merged are the Blackwell, Enid & Texas; the Oklahoma & Texas, and the Red River, Texas & Southern. (June 10, p. 450.)

SOUTHERN PACIFIC.—At a meeting of the directors of this company on June 15, a plan was approved for issuing $100,000,000 seven per cent. non-cumulative preferred stock. A meeting of the stockholders is called for a date early in July to pass on this proposal. According to the plans, $40,000,000 of the new stock will be issued at once and stockholders will be allowed to subscribe to the new issue at par to the extent of 20 per cent. of their holdings. The outstanding capital stock of the Southern Pacific is $197,849,227, of which amount $90,000,000 is owned by the Union Pacific. The total floating indebtedness of the Southern Pacific is about $30,000,000. A circular has been issued to the stockholders explaining the reasons for the new issue as follows: Large expenditures have been made in recent years for betterments and additions to existing lines for new equipment and the construction of wharves, docks, elevators and other improvements at Galveston. These expenditures were met chiefly from earnings and loans. In order to provide the capital necessary to discharge all floating debt, and for all additions and betterments authorized and contemplated during the next year, the issuance of preferred stock to the amount of $40,000,000 at this time is deemed expedient. The proceeds from the sale of this stock, in addition to providing for the needs above mentioned, will enable the company to refund bonded obligations maturing during the next three years, amounting to over $65,000,000, on a much more favorable basis of credit, and will leave over $30,000,000 of free and negotiable assets in the treasury.

TERRE HAUTE & INDIANAPOLIS.—The recent annual report of this company shows gross earnings on all lines operated of $5,124,299, an increase of $571,436. Operating expenses increased $729,178, leaving a decrease in net earnings of $157,742. The large increase in operating expenses was due largely to heavy expenditures for additions to equipment and betterment work on the T. H. & I. and the St. L., V. & T. H. The higher cost of locomotive fuel and of wages also helped to increase maintenance charges. After deducting all fixed charges, the surplus for the year was $335,419, a decrease of $111,041 over 1902.

TOLEDO RAILWAY & TERMINAL.—An official of this company has recently said that this road has not been sold to the syndicate which recently bought the Cincinnati, Hamilton & Dayton. A working agreement has been made however with the syndicate, and both the C. H. & D. and the Pere Marquette will in future have representatives on the Board of Directors of the Toledo Railway & Terminal Co.

WABASH-PITTSBURG TERMINAL.—This company has acquired the majority of the total capital stock of the Wheeling & Lake Erie. The total capitalization of the W. & L. E. is $20,000,000 of common stock, $5,000,000 of 4 per cent. non-cumulative first preferred stock and $12,000,000 of 4 per cent. non-cumulative second preferred stock. The company operates 470 miles of road between Toledo, Cleveland, Zanesville, Canton and Sherrodsville, besides controlling the Toledo Belt Line, the Cleveland Belt Line and other short branches.

EDITORIAL ANNOUNCEMENTS:

THE BRITISH AND EASTERN CONTINENTS edition of the Railroad Gazette is published each Friday at 35 Parliament street, London, S. W. It consists of most of the reading pages and all of the advertisement pages of the Railroad Gazette, together with additional British and foreign matter, and is issued under the name, Transport and Railroad Gazette.

CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

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RAILROAD GAZETTE

THE MANHATTAN BRIDGE.

Elsewhere in this issue is shown a collection of drawings to illustrate the principal engineering and architectural features of the new Manhattan bridge which is to span the East river, connecting New York and Brooklyn a short distance above the old Brooklyn bridge and considerably below the Williamsburgh bridge. Without consideration, for the moment, of its engineering features, the noteworthy thing about the Manhattan bridge is the very praiseworthy effort which has been to make of this great piece of engineering work an imposing monument. In the great cities of Europe it is almost taken as a matter of course that beauty and utility must exist together in municipal works, but here in America, perhaps to a greater degree in New York than in certain other parts of the country, we have always been overtaken by our necessities. We have met the demands of the crowding population with great promptness and we have solved many new problems as fast as they have arisen, but we have been so engaged in thus considering the fundamental requirements of the growth in population that we have perhaps not always stopped to consider that our great municipal works must nevertheless stand as monuments, either of beauty or of ugliness, for generations. The use of steel, particularly of steel piers, in great bridges, tends to violate the architectural principle that for beauty's sake there should be seemingly ample support for whatever is supported. The strength of steel is so great in proportion to its section area that the eye gets a sense of inadequacy in viewing a massive roadway supported by slender towers and threadlike cables. A glance at the Manhattan bridge drawings will show how the architects, Messrs. Carrere & Hastings, have considered this and placed corbels in those places where the eye naturally seeks to find some buttress or reinforcement of the slender supports. By the pains taken in this and in other matters to treat the bridge as a monument instead of merely a traffic necessity, it loses no beauty as an engineering work, but gains the grace and dignity which befit the municipal engineering works of the greatest American city.

RESPONSIBILITY FOR GRADE CROSSING ACCIDENTS.

It is perhaps unduly severe to say that Governor Odell, of the State of New York, is guilty of murder in any degree in the killing of Frank B. Read at Van Cortlandt Park on June 12; yet this and other frequent grade-crossing accidents were caused quite directly by him. So high-placed an officer should be presumed to have full knowledge of the fatal results of preventing the elimination of points where highways cross railroad tracks at grade. The records of years of killing and maiming at these points, increasing with increases of speed and density of traffic, were available to him, and during the years of his unfeeling opposition to this simple measure for saving life they have often been collected and presented to him in forms understandable by a most primitive mind. Nevertheless, he continues to veto the moderate appropriations needed for the fulfilment of a most beneficent law. And he kills people.

The Governor's point of view in the matter, if he has any, seems to be that grade-crossing removal is the sole concern of the railroad, and that State funds are needed for other purposes, such as escorting personally conducted parties to St. Louis. But the matter is fully covered by law, which takes into consideration the fact that many existing grade crossings date back through a long period of years to the time when the establishment of communication was the immediate necessity and the great congestion of population about large cities had scarcely begun. From the early desires of the commonwealth for means of transit and the absence of laws to the contrary, it is fair to say that the State of New York in early times assumed the responsibility for grade crossings, and it is obviously fair to suppose that some share at least of this responsibility still remains. Under the present laws if a new railroad crosses an existing highway, the expense of avoiding a grade crossing must be borne entirely by the railroad, and if a new highway is built crossing an existing railroad the expense is rightfully shared alike by the municipality which demands the highway and the railroad which by its location obstructs it. But where there are existing crossings—and they are shockingly numerous in the highly populated State of New York—half the expense of removal is to be borne by the railroad and the balance is divided equally between the municipality and the State. The cost to the railroad of grade-crossing removal, therefore, is twice as great as the cost to the State; yet, at the present time, the railroads in New York are most anxious to prosecute this work with zeal, and are provokingly delayed by the action of the State's chief officer, and by him alone.

The present grade-crossing law went into effect in 1897, prior to which the only crossings eliminated were those changed voluntarily by the railroad companies, or through mutual arrangements with the towns and municipalities. The law now provides for an annual appropriation by the Legislature out of any moneys not otherwise appropriated of $100,000, to pay the State's share of the expense of removing existing highway crossings from grade. That is to say, $400,000 a year is all that may be spent for this purpose, after the State's contribution has been swelled by the share borne by the railroads and the municipalities, respectively; but, if less than this is spent during any year, the balance, instead of going to the credit of the account, becomes part of the appropriation for the ensuing year, and does not increase it. Last year the Legislature appropriated sums for prosecuting the elimination of grade crossings generally throughout the State, and for two or three particular localities. The Governor vetoed all of these sums with the sole exception of $75,000 toward the total estimated cost of the State's appropriation of $275,000 for Schenectady.

This year the State Legislature appropriated the following sums:

(1) For general grade-crossing work still unexpended on sums appropriated two years ago, which, under the law, has to be re-appropriated, $74,893.

It is to be very much regretted that the Governor vetoed this appropriation, so that work which was started two years ago in good faith on sums then appropriated, has either to be discontinued or taken care of from the sum mentioned below in paragraph 3.

(2) For general grade-crossing work, not to be expended until next year and several years thereafter, so as to enable the Board of Railroad Commissioners to consider plans and approve them with the knowledge that money was available with which to do the work, $200,000.

This amount was vetoed by the Governor, so that the Railroad Commissioners are unable to consider and approve plans for which they have not the money in sight.

(3) For general grade-crossing work throughout the State, $150,000.

Out of this sum must come the $74,893 that remains unspent from the appropriation of two years ago, since the re-appropriation was vetoed by the Governor; and it must also provide for the further sum of about $25,000 for the expenditure of which the Railroad Commissioners are committed by previous action; so that there now remains available not over about $50,000 to be applied on work to be approved by the Railroad Commissioners, and this work may be still further decreased by cost in excess of estimates.

In other words, the great State of New York, with its 8,000 miles of railroad and 8,600 grade crossings, has less than $50,000 with which to continue the work of eliminating these crossings, to compare with the half million dollars appropriated annually by the State of Massachusetts for the same purpose. For the past two years the three parties in interest—the railroad company, the municipality, and the State, through its Legislature—have been willing and anxious to spend the money required to carry out grade-crossing elimination; yet, the will of these parties in interest is thwarted by the action of one man, who, for his own reasons, continues systematically to veto appropriations.

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The circular of the British Board of Trade which is printed in another column embodies the recommendations which have been made from time to time by Mr. George Westinghouse as to precautions necessary for the safe operation of electric trains. The attitude of Mr. Westinghouse on this question has always been broad and far-sighted, and on several occasions he has taken pains to point out, freely and candidly, the danger places in electric traction, particularly as applied to elevated or subway lines, where the egress of passengers in case of accident is necessarily restricted. The danger due to the third rail has not been directly mentioned in the Board of Trade regulations, but the precautions demanded in the construction of the cars, roadbed, stations, etc., if conscientiously carried out, will reduce the third rail dangers to a minimum.

The Board of Trade takes a decided stand

on the use of multiple unit control in section 9 of its report, which says: "No main electric cable to be carried through the train, and motors to be placed on the front and rear carriages only. No motor to be situated in the middle of the train." The current required by a train of several cars is sufficient, if short circuited, to melt a good-size section of iron or steel and set fire to the woodwork about the car, roadbed or stations. As is well known, in the multiple unit system, each car takes up only enough power for its own operation, thus eliminating the use of a main electric cable passing beneath the entire train. The regulation prohibiting motor cars in the middle of the train will make necessary some changes in the make-up of trains on several of the London underground roads. The Great Northern & City line now runs seven-car trains consisting of three motor cars and four trailers. Each motor car has 250 horse-power in motors, so that if seven-car trains are still run, the use of but two motor cars, one at the head and one at the rear of the train, will cut down the power available for acceleration by 33⅓ per cent. High acceleration is one of the important features of electric traction, and where stops are frequent the average speed of a trip is dependent on the acceleration obtained on leaving stations. Of course, an underground road's acceleration is not so important as on surface or elevated roads, because the number of stops is not so large. The Central London Underground Railway runs six-car trains, including a motor car at each end of the train, but this arrangement of cars was made necessary because the tunnel is not high enough for cars having motors beneath the floor. The motor cars used are of special construction, the floor being raised over the trucks which carry the motors. In case of fire the use of a motor car at each end of a train is, of course, an element of safety, as the burning motor car can be quickly uncoupled from the train, but with the precautions taken to make the cars incombustible it is quite possible that this provision is unnecessary.

The full statement of precautionary rules and measures for the New York subway has not yet been made public, but, leaving out of the discussion the arrangement of motor cars, it may be said that the New York requirements will be in every respect equal, if not superior, to those laid down by the British Board of Trade. For example, all the lighting in the New York subway is to be done by circuits independent of the power circuit, while the British requirements provide only that "not less than 25 per cent. of the lights" be supplied from independent sources. Our signal system is the best that human skill can provide, and the steel cars, designed to supersede the experimental cars now in use on the elevated, are as nearly incombustible as possible.

Railroads of the United Kingdom in 1903.

The preliminary summary for the year 1903, in comparison with the two previous years, gives the total length of line open for traffic at 22,380 miles, as against 22,152 miles in 1902 and 22,078 miles in 1901. Of the present mileage, 9,905 miles consist of single track, and the rest of double, or more. There was an addition of about 100 miles of single track line during the past year, and of about 125 miles of double, or more. The following table of gross earnings, reduced to American currency, shows that the earnings from third-class traffic are over eight times as great as from either first or second (second-class, however, is found on relatively few trains).

There was a slight gain in the receipts from all branches of passenger traffic, except first-class, which was somewhat smaller than it was last year. The total freight earnings have also showed what we, in this country, would call a small but steady increase since 1901. Expenses have kept to a moderate ratio of increase, and in the item of locomotive power have shown quite a notable decrease, in view of the traffic gains, so that net earnings make a good showing.

But the favorable net earnings are subject to a certain modification before they can be in any way compared with American practice, for a large betterment charge, which in this country would quite universally be charged against earnings, is here piled up on the other side of the account. The English shareholder insists on receiving a full division of the balance of what is left after

	1901.	1902.	1903. (Prelim. figures.)
Total capitalization, paid up	$5,810,443,363	$5,913,946,506	$6,049,888,380
Gross receipts:			
From passenger traffic:			
1st class	$17,111,880	$17,297,984	$17,146,080
2d class	15,073,110	16,015,829	16,208,100
3d class	140,455,210	141,203,893	141,848,820
Season tickets	17,366,617	18,048,738	19,051,200
Excess luggage, parcels, etc	31,394,152	32,419,602	33,354,180
Mails	5,220,175	5,342,015	5,438,340
Total from passenger traffic	$226,621,144	$230,328,060	$233,046,720
From goods traffic	$257,412,665	$265,689,197	267,834,600
Total gross receipts	$518,152,560	$532,301,030	$539,095,500
Working expenditure:			
Maintenance of way, works, etc	$48,239,242	$49,603,760	$51,117,480
Locomotive power	94,789,503	90,790,209	89,895,420
Repairs and renewals of carriages and wagons	26,024,050	26,730,349	27,143,100
Traffic expenses	96,620,284	98,236,171	98,964,180
Rates and taxes	19,343,577	20,546,101	21,811,680
Other	43,260,191	44,079,918	44,362,080
Total	$328,276,850	$329,986,510	$333,293,940
Net receipts	$189,875,709	$202,314,519	$205,810,560

operation costs and a very limited charge against earnings to maintain the property. Even if we are extremists in the other point of view—that property which is merely maintained is in a constant state of depreciation or of stagnancy, and that it should be substantially better every year before anything is divided—the American reader stands rather aghast at the accumulated capitalization which has been created by the English practice. In 1901 the total paid-up capital per mile of road was $263,178; in 1902 it was $266,971, and in 1903 $270,326. The American critic, although he understands fully the difference in conditions, the populous country through which the lines pass, and the stringent board of trade regulations, which cost the companies annually a pretty sum of money over and above that from the expenditure of which any increase in public safety is visible, is disposed to ask where the thing is going to end. If earnings can increase fast enough to pay interest and at the same time provide always for dividends on the augmented stock, well and good; but it would seem that this could hardly be expected in a country already so densely populated as the British Isles. It seems to the American observer, who simply sees British conditions from afar and gets a perspective instead of an intimate knowledge of traffic conditions, that in Great Britain the time cannot be far off when the increases in fixed charges will overtake the increases in net earnings.

Railroad Gross Earnings for May.

Although railroad gross earnings for the month of May show a decrease over the same month last year, this decrease is not so large as was expected after the appearance of the reports of April earnings. Eighty-one roads report a decrease in gross from May, 1903, of $2,811,823. Of 56 of the more important railroads reporting gross earnings for the month, 36 show decreases. But while the decreases in April were found in all parts of the country, those for May are marked only in the Northwest, Southwest and Middle West. The factors which worked toward the decrease in gross for May may be summarized as follows: The presidential election making trade very quiet; labor troubles, especially in Colorado; and late rains in the Southwest. And it should be taken into consideration that gross earnings in May, 1903, were abnormally heavy.

In the Middle West the movement of general merchandise has been extremely sluggish. In certain cases the decrease can be traced more specifically, as in the loss of $218,610 reported by the Hocking Valley Railroad, due directly to the suspension of the movement of soft coal toward the lower lake ports, owing to the lake strike. This strike was also felt by the Illinois Central, the Toledo & Ohio Central and the Wheeling & Lake Erie. This trouble on the lakes is now ended. The continued suspension of lake navigation, on the other hand, has undoubtedly helped the May earnings of the Pere Marquette, the Wabash, the C. C. C. & St. L. and the Grand Trunk.

In the Southwest the traffic movement has been in general fair, but the strike in Colorado and heavy floods in Arkansas and Texas have caused some serious shrinkages. Among the railroads showing decreases in this section are the Colorado & Southern, with a loss of $141,708; the International & Great Northern, with a loss of $111,560; the Denver & Rio Grande, $102,400, and the Texas & Pacific, $114,311.

In the Northwest the situation is similar to that in the Middle West, with the exception that the lake tie-up has not been so severely felt. The movement of merchandise is, however, very light compared with the volume carried last year at this time.

Gross earnings for May, when divided geographically, show decreases summarized as follows: Southwest and South Pacific group (ten railroads), decrease $395,270; Middle and Middle West group (13 railroads), decrease $369,876; Northwest and North Pacific group (13 railroads), decrease $1,089,-744; Trunk Lines (six railroads), decrease

$1,223,903; Southern group (ten railroads), increase $168,248. As some of the railroads in the Trunk line and anthracite groups have not as yet reported earnings, the showing may yet be improved.

Of the separate roads, several have reported fair increase over May, 1903. The most noteworthy of these are the Canadian Pacific, which shows an increase of $209,000; the Mobile & Ohio, with an increase of $128,711; the Atchison, Topeka & Santa Fe, with $123,346, and the Central of New Jersey, which shows an increase of $85,639 for the month. In direct contrast to this, however, the New York Central & Hudson River and the Baltimore & Ohio show decreases for the month of $342,480 and $475,903 respectively. The Chicago and North Western and the Illinois Central also show losses of $500,946 and $284,474 respectively.

In general it may be said that as the losses are mostly in the Middle West and Southwest where the trouble is due to strikes, it may be assumed that the root of the trouble is not permanent. As soon as these strikes are over, the products of the mines will again move.

May Accidents.

The condensed record of the principal train accidents which occurred in the United States in the month of May, printed in another column, contains accounts of 14 collisions, 25 derailments, and 5 other accidents. Those which were most serious, or which are of special interest by reason of their causes or attending circumstances, occurred as follows:

	Killed.	Injured.
1st. Dayton, Tex.	0	0
2d. Shevlin, Minn	0	8
8th. Huachuca, Ariz.	2	2
10th. Port Chester, N. Y.	2	0
11th. Rock Fish, Va.	2	0
17th. Moorcraft, Wyo.	1	3
22d. Pine Bluff, Ark.	.	.
25th. Haughton, La.	2	6
26th. Alton, Ill.	0	1

Eight of these nine accidents are notable, from the standpoint of our record, only on account of their magnitude; the causes, so far as appears from the details given, are not different from those of scores of other collisions and derailments to be found in the current reports. The ninth accident, that at Pine Bluff, Ark., is notable mainly by reason of its insignificant cause, a hot box. Butting collisions, costly in property loss and disastrous to lives are prominent in the record, as usual, but none of them appears to be exceptional. The derailment at Portchester, N. Y., has given rise to some speculation as to the best way of arranging signals at the approach to crossovers, on four-track lines, in situations where it is desirable to run trains from one track to another at full speed, or at the highest speed practicable. The view is expressed that unless the signal arm for indicating the highest-speed is always fixed highest on the post the engineman's difficulties are unnecessarily increased; and it is also argued that if the arm which is second in importance is at some places cleared for a fast train (the crossover being safe at say 40 or 50 miles an hour) the practice will lead enginemen (receiving a precisely similar signal) to run fast through some other crossover where the curvature is not so favorable. Costly derailments of passenger trains have occurred in this way. While these are interesting questions, it is important to bear in mind that they do not relieve the superintendent of the old, hard and persistent problem of training his enginemen to carefulness and vigilance; to the combination of cautiousness and the spirit of hustle which is necessary to make time and still be safe. Enginemen who run past a given signal every day may and ought to become so familiar with it that no amount of different circumstances at other places can confuse them concerning it. Theoretical discussions in the office sometimes seem to ignore this element of the problem. While it is the duty of the signal engineer to simplify signal indications for the benefit of enginemen, it is the duty of the superintendent to have runners who are equal to all difficulties. Simplifying signals paves the way for the employment of runners with poorer brains; but will any superintendent say that he should take advantage of the opportunity thus offered? Of course not; the quest for better brains remains a duty.

The number of electric car accidents reported in the newspapers in May was 22, in which four persons were killed and 99 injured.

According to the Chicago *Record-Herald* the Railway Protective Bureau, the organization which has been established by the cooperation of many railroads to do what it can to stamp out the ticket-scalping industry, has found rottenness in its own constituency. Many irregularities attending the issue of Exposition tickets to St. Louis have been disclosed, and the bureau, therefore, sends a plainly worded circular letter to the railroads in the association, reminding them that some of them are not dealing fairly with the courts. In securing an injunction a few weeks ago forbidding Chicago brokers to deal in non-transferable tickets, the railroad lawyers enlarged upon the excellence of the protective features of their tickets and gave the court to understand that these protective features had been universally adopted. The courts accepted these features as proper and reasonable and have prohibited the fraudulent representation which their transfer to other than the original purchaser involves. "If, therefore," says the circular, "the lines refuse to avail themselves of these protections by issuing the tickets in blank or by negligent execution of the contracts, they are in contempt of the tribunals of whom they have asked protection and redress, and have nullified the efforts of the courts in their behalf. . . . Connivance at fraud and complicity with questionable transactions on the part of lines which have pledged themselves to connections and competitors, have already resulted in material loss to the carriers generally and in profit and encouragement for the ticket scalpers. . . ." And the hope is expressed that, before it is too late, the evils will be remedied. The salient feature of this circular is that the facts stated are very like the facts which have been reported in so many other cases for 25 years past. The ticket scalper's nature seems never to change, even when he becomes a general passenger agent. It will be interesting to see what, if any, notice is taken of this situation by the judge who granted the recent injunction. Failure to keep faith with a rival railroad is one thing; failure to keep faith with a United States Court may prove to be quite another. It would help to clear the atmosphere if passenger men who do not keep their word could be brought before the courts now and then; the light of publicity would be beneficial.

TRADE CATALOGUES.

The Chicago Pneumatic Tool Co. has issued a 72-page catalogue of air compressors built at its Franklin, Pa., works. All types of compressors built by the company are illustrated and described, including the new type G. Lists of sizes with full descriptive details accompany each class shown. A general description of the compressors is given, and several pages are devoted to constructive principles, the different important features being illustrated and described in detail. The volume also includes information of various sorts, of interest in connection with compressors and compressed air. The company is also sending out a small circular relative to the Duntley air-cooled electric drill. It is wound for 110 or 220 volts, and is made in sizes corresponding to the "Little Giant" pneumatic drills. The size illustrated in the circular weighs 12 lbs., drills up to ½ in. diameter in iron and ¾ in. in wood, and runs at 850 r.p.m. They are fitted with breast plate and feed screw when desired.

The Union Pacific issues a folder containing particulars of the U. S. Government grant in Nebraska; also a map of its road and connections and a map in colors of that part of Western Nebraska showing the public lands opened for distribution by the Government and those for sale by the company.

British Precautions Against Subway Disasters.

The British Board of Trade has issued the following circular of precautionary standard specifications and instructions to be observed by underground electric railways. Further comment on these regulations will be found in the editorial columns:

STATIONS AND PERMANENT WAY.

1. Sleepers to be of hard wood, not creosoted, and to be laid in concrete or ballast, and covered with a layer of gravel or finely broken stone free from dust, the ballast to be finished to a level surface, so as to form a convenient roadway for passengers in case of emergency. If ballast is not used, the space between the rails to be covered with granolithic slabs, or slabs of a similar material, to form as wide a roadway as possible for passengers. No timber planks to be used.

2. Tunnels to be provided with lights capable of being turned on from the stations at either end of each section, and, if necessary, at some intermediate points. The lighting circuits to be independent of the traction supply.

3. Separate entrances to and exits from each platform of the stations to be provided, and to be situated as nearly as possible in the middle of the platforms.

4. All stairways, passages, and exits from the stations to be conspicuously lighted. Not less than 25 per cent. of the lights in these places to be supplied from independent source. If necessary, the exits to be made more conspicuous by the use of colored lights, in addition to white lights.

5. Platforms not to be made of wood, and woodwork to be eliminated as far as possible from signal boxes, lifts, offices, etc., below ground.

6. Efficient hydrants, hose and fire prevention appliances to be provided.

7. Ventilating ways to be provided wherever possible from the station and the tunnels to the surface.

EQUIPMENT.

8. Cars to be constructed of metal; woodwork to be reduced to a minimum, and to be non-inflammable. Hard wood to be used in preference to soft. Interior fittings, panels, seats, etc., to be of incombustible material.

9. No main electric cable to be carried through the train, and motors to be placed on the front and rear carriages only. No motor to be situated in the middle of the train.

10. Means to be provided at both ends of every train to enable passengers to alight from the cars in case of emergency. Oil lamps to be carried in every train.

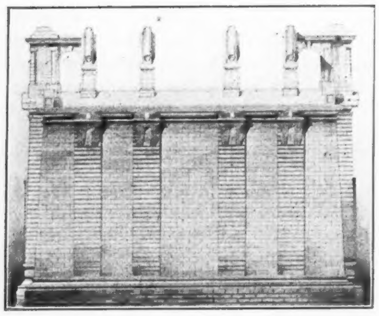
11. India rubber or other inflammable insulating materials to be avoided as much as possible, and the outer covering of cables to be uninflammable material that will not give off smoke.

12. Means to be provided for enabling a driver at any part of the tunnel to put himself into telephonic communication with the adjacent stations.

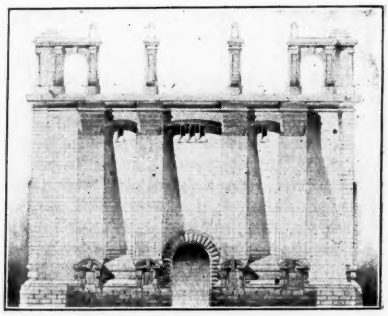
HERBERT JEKYLL.

Board of Trade (Railway Department), May, 1904.

Architectural Features of the Manhattan Bridge.

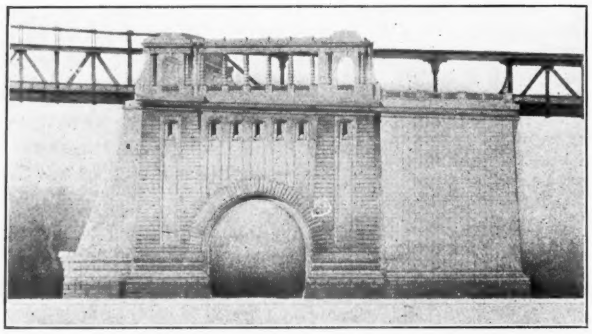


Front Elevation of Anchorage.

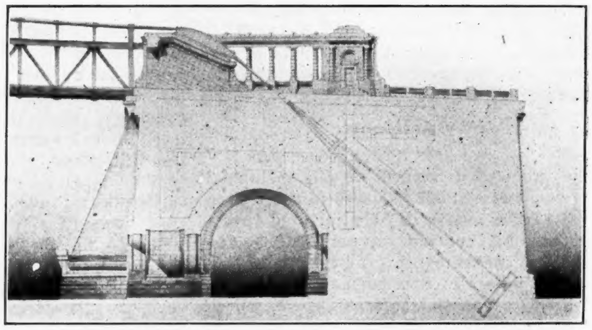


Back Elevation of Anchorage.

The accompanying illustrations are from photographs of the architect's drawings for the new Manhattan Bridge across the East river just above the Brooklyn Bridge. Officially this bridge is known as No. 3 and is a part of the extensive plans made shortly after the Brooklyn Bridge was built for connecting the then independent cities of New York and Brooklyn. The Williamsburgh Bridge, or No. 2, was opened for foot and wagon traffic last December, and No. 4 or the Blackwell's Island Bridge is almost ready for the erection of the superstructure. The first plans for the Manhattan Bridge were prepared some years ago by Mr. R. S. Buck, Chief Engineer under Bridge Commissioner Shea. They called for a three-span suspension bridge with straight carbon steel



Side Elevation of Anchorage.

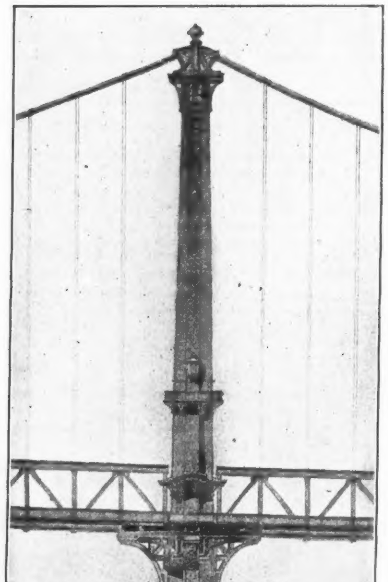


Section through Anchorage.

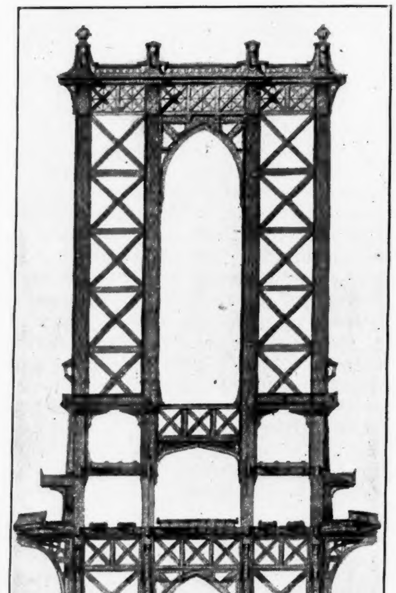
wire cables and a suspended stiffening truss, hinged at the towers and anchorages and continuous over the centers of all three spans. The clear span was fixed at 1,470 ft., with two identical shore spans, each 725 ft. long. The towers were steel, each comprising eight braced legs, self-contained and fixed at the base. This design was fully developed and a large number of drawings made when Mr. Gustav Lindenthal came into the office of Bridge Commissioner and undertook to redesign the entire bridge, using the same spans on account of the fact that work on the masonry foundations of the piers had already been begun. His substitute design called for a three-span suspension bridge with nickel-steel eye-bar chain cables instead of wire cables and with spandrel trussing connected directly with the chain cables instead of the suspended stiffening truss. The towers consisted of four massive legs braced transversely but hinged at the bottom to rock longitudinally. The trussed chains were hinged at the top and bottom. The general features of this design were fully described in the *Railroad Gazette*, December 4, 1903.

When the present Bridge Commissioner, Mr. Best, took office, last January, the original plans were again taken up and revised with the view of soon beginning work on the superstructure. Several changes were made in the original plans while still preserving the general features of wire cables, steel towers and suspended stiffening truss. The plans were then submitted to Messrs. Carrere & Hastings to be studied and embellished architecturally. The result of their work, which has the approval of the Municipal Art Commission, is shown in the accompanying illustrations. A report which they recently submitted to the Bridge Commissioner in connection with the studies which they have made says in part:

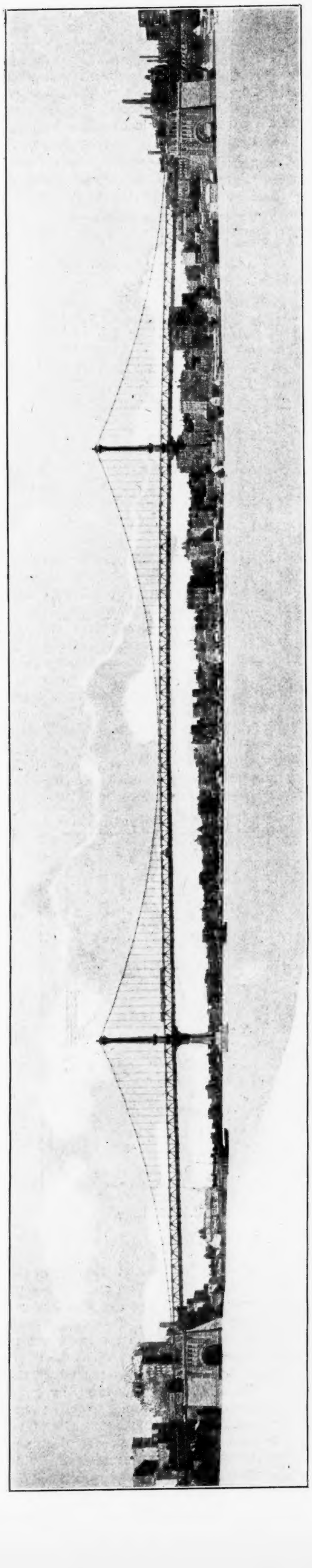
If the two existing bridges, the Brooklyn



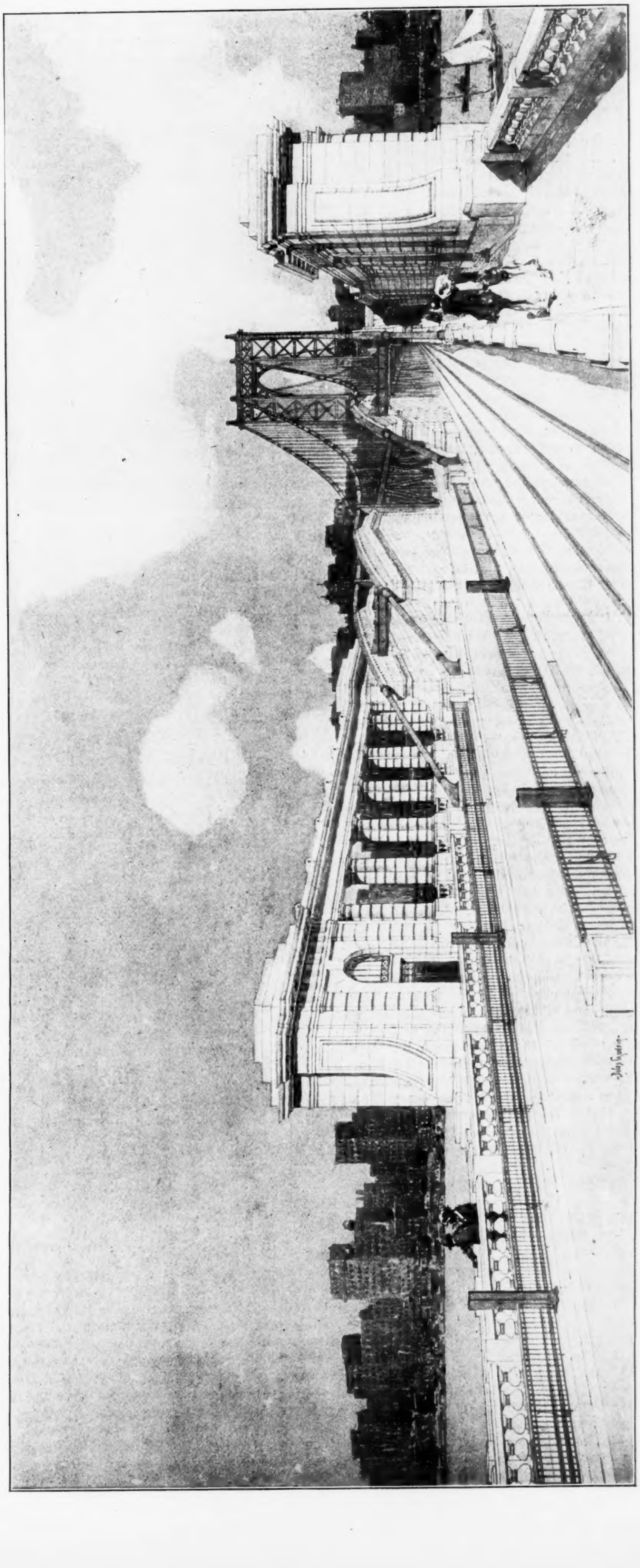
Side Elevation of Tower.



Elevation of Tower from Roadway.



General View of the Manhattan Bridge from the River.



Roadway over the Anchorage, Showing Colonnades.

Bridge and Williamsburgh Bridge, were compared without thought or architectural study or detail, attention would be strongly drawn to the impressiveness and charm of stone and iron combined in the construction as seen above the roadbed on the Brooklyn Bridge, No. 1, and which is wanting in the other.

From the engineering and practical point of view it is a mistake to build the main towers of such a bridge of stone, because the openings in the towers must be so diminished in size in order to be made of masonry as to materially curtail the volume of traffic over such a thoroughfare. It is, therefore, impossible to obtain any effect of masonry above the roadbed by building the towers of stone, but it is necessary for the sake of harmony that there should be some expression in stone above the roadbed of the immense amount of masonry necessary under the roadbed for the construction of the anchorage. This affords an opportunity of bringing stone construction in contact with the great amount of necessary iron construction, and, on the other hand, makes it evident to all crossing the bridge that they are on the anchorage, by some other visible signs than by the mere change in the pavement material. In such a bridge any mere matters of architectural detail in the ironwork are lost in such a forest of structural steel work. The first and most important feature in design is the stone work over the anchorage. This anchorage is about 225 ft. long x 175 ft. wide and nothing could be more impressive than the court treatment 120 ft. above the water level. This treatment of the anchorage has made it possible to obtain an extra width at this part of the thoroughfare and has given places off from the general circulation where people can rest under cover on their way over the bridge and obtain a view of the distant city and the surrounding waters.

An endeavor has been made to utilize the necessary masonry supports for the anchorage saddles in making them a part of the architectural scheme connecting the colonnade; one of the pavilions of the colonnade on either side of the anchorage is devoted to staircases, which connect with the interior of the anchorage and which will be finally connected with the street. The architecture of this anchorage as seen from the street is one of the most interesting portions of the bridge which has been treated, and it has been the endeavor to avoid any unnecessary ornament, using only structural decoration and obtaining the artistic effect by the large masses of material and stone jointing. All of the enrichment has been concentrated upon that portion of the anchorage which comes under the colonnade and which expresses an interior void. That portion of the anchorage which carries the principal amount of the real load has been kept simple and massive in contrast with the other.

The perspective which is shown gives an idea of the relation of a mass of stone to the iron work over the roadbed; it also shows the court, which it is believed will be the most impressive feature of the bridge. Money will be better spent there than by spreading detail over so large a construction. The lines of the towers as given to the architects by the engineers are the expression of an economic and mathematical construction; these lines in themselves are most beautiful and need but little decoration, and such decoration as has been given has been concentrated to accentuate in every way the lines of the construction. Another opportunity has been afforded here to obtain covered resting places on the way over the bridge, and at the same time by making an iron and copper hood to enrich and obtain a shadow at this point. Another and most important feature from the architectural point of view is the crowning of these steel towers. Any mere decorative treatment on top of these towers and above the cables, coming against an open sky and on so large a construction would be at best inadequate and undignified. It has therefore been the endeavor to simply crown them with a cornice effect and to keep this crowning under the lines of the cable, like the cap of a column under an architrave. This cornice has been made of heavy iron with a large projection and all the decorative features have been concentrated in a gallery effect the whole width of the tower. The main lines of the cables and suspended trusses as given by the engineers are beautiful in themselves, expressing, as they do, the rational and simple solution of the problem from the engineering point of view.

The Austrian government thought it necessary to increase its income by imposing a tax on railroad tickets. One of the principal private railroads reports as follows what it had to do in order to collect this tax during the year 1903, when it amounted on its lines to a little more than $400,000: 8,376,000 new tickets had to be printed, distributed and placed on sale, some 210,000 other kinds of printed papers provided, and 5,000,000 old tickets, no longer usable, called in, counted and destroyed. It is quite convenient for the State to use the railroad companies as tax gatherers, but not so agreeable to the companies.

Railroad Shop Tools.

(Continued.)

(WHEEL LATHES.)

Only a few builders of machine tools make wheel lathes. This is due to the fact that this class of tools is special and is used only by railroads and locomotive builders, and hence the number sold is relatively small, as compared to other classes of tools. The Niles-Bement-Pond 80-in. driving wheel lathe (Fig. 1) was recently built for the Louisville & Nashville, and one of these machines is also exhibited at the St. Louis Exposition. The swing of this lathe is 80 in. over the bed and 72 in. over the carriages. The face-plates are 80 in. in diameter and are driven by a steel pinion engaging in an internal gear on the face-plate. The pinions are attached to auxiliary shafts in the headstock, and on the opposite end of each auxiliary shaft is mounted a spur gear driven by a pinion on the main driving shaft, which traverses the length of the bed. Heretofore in driving wheel lathes one of the sources of weakness has been the long driving shaft, causing chattering in the machine by its torsion. The method adopted in this machine of gearing and driving shaft into the face-plates relieves the shaft of a very large part of the strain found in the usual construction.

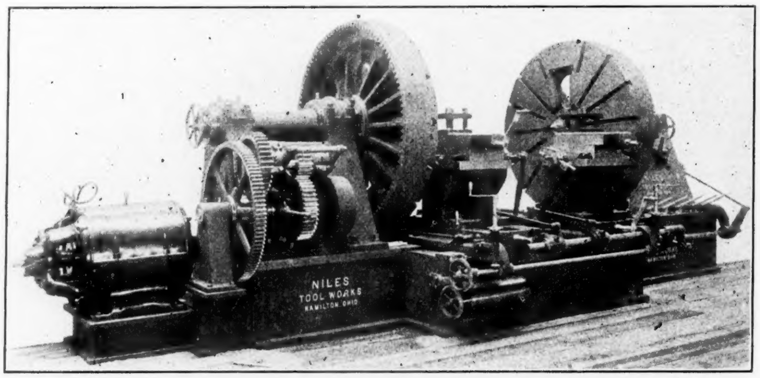


Fig. 1—Niles-Bement-Pond 80-in. Wheel Lathe.

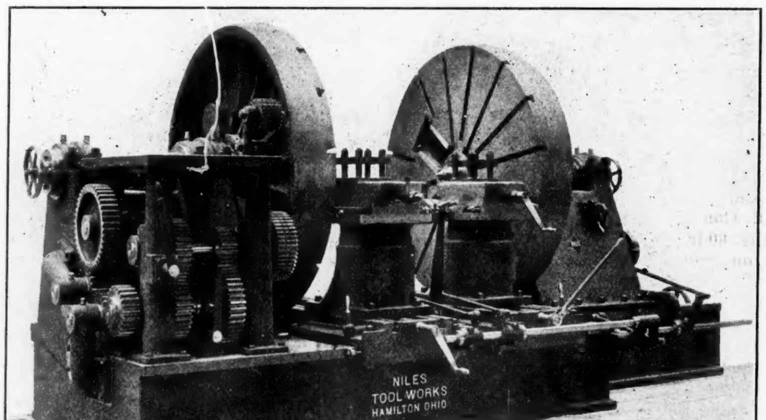


Fig. 2—Niles-Bement-Pond 90-in. Wheel Lathe.

The main driving motor is placed at the left-hand end of the machine and, by gearing, transmits motion to the face-plates both for tire and journal turning. The face-plate speeds for tire turning are designed to give cutting speeds ranging from 10 to 22 ft. per minute on diameters ranging from

48 in. to 68 in. on the tread. The motor has a speed range of 1:3. The axle is put into the machine on centers, each headstock has a sliding spindle in which the centers are inserted. Each face-plate has an opening for the crank-pins, so that the wheels can be brought close to the face-plates.

The right-hand headstock is moved into position by a 3½ h.-p. motor. The carriage and tool-rests engage with an adjusting screw lying lengthwise in the bed by an opening and closing nut operated by a 3½ h.-p. motor. This enables each carriage to be moved on the bed by power in either direction, making the adjustment of each carriage independent of the other. The feeds are operated by an adjustable crank-plate driven by gearing on the right-hand headstock. From here the motion is conveyed to the feed-screws by a rock-shaft placed on the front of the bed and connected by ratchets to the screws.

The face-plate spindles are gun-iron castings. Both the front and the rear bearings of the spindle are fitted with heavy bronze bushings made in halves. All the driving shafts have bronze bearings. All the smaller pinions are forged steel and the larger gears and the gears on the face-plates are made of gun-iron or semi-steel castings. The 90-in. wheel lathe shown in Fig. 2 was built for the Canadian Pacific by the Niles-Bement-Pond Company and is similar in design to the 80-in. lathe just described. An induction motor is used to drive this machine. This accounts for the rather complicated gearing, as the speed changes had to be made by gearing instead of electric control.

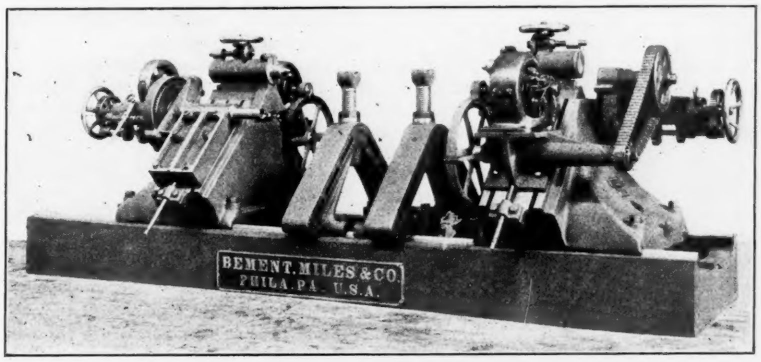


Fig. 4—Niles-Bement-Pond Quartering Machine.

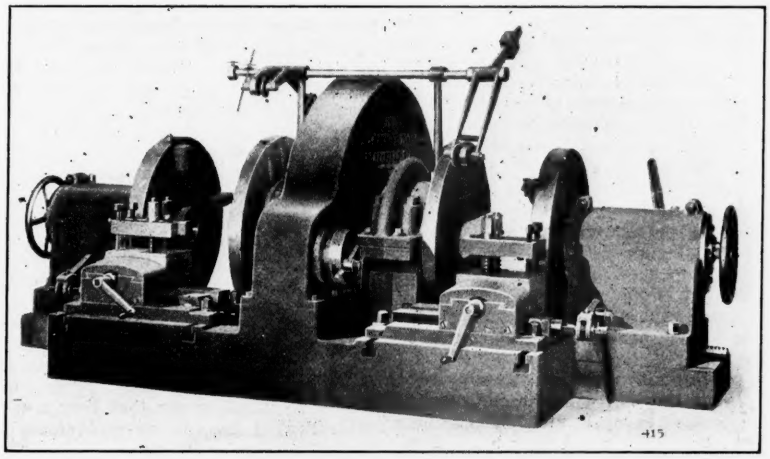


Fig. 3—Niles-Bement-Pond Car Wheel Lathe.

The Pond car wheel lathe shown in Fig. 3 will turn car wheels up to 42 in. in diameter. Self-centering chucks to grasp the axle journals, and chuck jaws to engage the tires, are provided. There has always been more or less difficulty in holding the wheels sufficiently rigid to allow the full power of the machine to be used at the tool without straining the axles. This machine is provided with a special device by means of which the wheels are securely wedged between the face-plates and the driving-plates. This prevents the axles from being strained when the machine is worked at its full capacity. The tool slides are operated either by hand or by positive power feed, and can be set to give any desired coning to the tread of the wheels. This lathe has a record for turning from 5 to 7 pairs of wheels per day.

The quartering machine shown in Fig. 4 is designed for quartering wheels with either right of left hand lead up to 80 in. in diameter on the tread. The maximum distance between centers is 9 ft. The saddles have angular adjustment for any length of stroke from 12 to 34 in. The boring spindles have 15 in. traverse, two changes of power feed and rapid hand movement. The motor drive feature of the machine is rather a novel design. In order to change from right to left hand quartering, the base on which the motor stands is placed on the other side of the machine, and the part which now forms the base for the motor is placed in contact with the slide of the machine, and the part which now is in contact with the slide forms the base for the motor. The tension in the chain drive is regulated by an adjusting-screw.

The Putnam Machine Company's 92-in. driving wheel lathe is shown in Fig. 5. A novel feature of this machine is the arrangement of the tool carriages, each of which is in two sections. The front and rear sections of the carriages are fitted upon separate sets of ways, and when the tool blocks are in the forward position for turning the tires the rear sections are placed together between the driving wheels, so as not to interfere with them. After the tires are turned, the front carriages are set over, so that their T slots come into line with those of the rear carriages. The tool blocks are then moved up, automatically connecting the front and rear carriage sections so that the operator can proceed to turn up the journals. The lathe is fitted with the Putnam standard quartering attachment on both the head and the tail stock for boring crank-pin holes. On the head stock the boring attachment is placed vertically above the main spindle, while on the tail stock it is placed horizontally at the rear. The boring attachment is adjusted for boring crank-pin holes for the different strokes of piston by means of the hand wheel shown. The main driving shaft of this lathe is steel, 7⅛ in. in diameter, and is supported in the middle to prevent vibration. The internal spindles are 50 in. long and 8 in. in diameter; they are fitted with tool steel center points, which are 4 in. in their largest diameter. Outside reinforcing hold-fasts are provided, and these are bolted directly to the face plates. The diameter of the primary face-plate gears is 90 in. The face of the cogs is 7½ in. and the circumferential pitch is 2½ in. The feed mechanism is arranged to give tool feeds ranging from .002 to 0.1875 in. per revolution of the work. The maximum swing of the lathe is 92½ in. The greatest distance between centers is 8 ft. 1 in., and the bed is 20 ft. 4 in. long by 6 ft. 9 in. wide. The weight of the machine is 77,500 lbs.

(To be continued.)

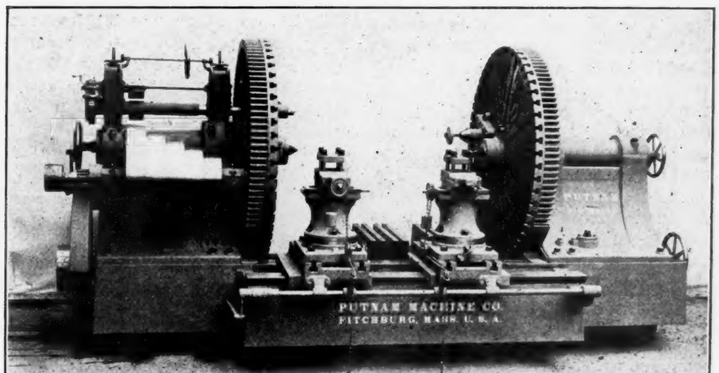


Fig. 5—Putnam Machine Company's 92-in. Wheel Lathe.

Master Car Builders' Convention.

The 38th Annual Convention of the Master Car Builders' Association was held at Saratoga Springs, N. Y., June 22, 23 and 24. The attendance was larger than ever before and more than the usual interest was taken in the discussions. President F. W. Brazier, New York Central, presided. The first meeting was called at 10 a. m. and after a prayer and an address of welcome Mr. H. H. Vreeland, President of the New York City Railway Company, made a brief address. He said, in part:

"A few years ago I made an address before a body of railroad men which I termed a prophecy of the advance of long-distance electric traction. To-day that prophecy has come true and I now stand before you, not as a prophet, but as herald. . . . In and about New York there is now in progress of installation a practically new means of propulsion as applied to steam railroads. With the introduction of electricity at the New York termini of the New York Central, and possibly the Pennsylvania, there will come into use a new class of vehicle each with individually contained power apparatus, and the intimate association between the vehicle and the mechanism of its propulsion is so close as to make the divorcing of them practically impossible. The day when the motive power was sent to a roundhouse and the inert rolling stock to a yard or shop is at an end. A young man who aspires to shop efficiency must in the very nature of things find himself equipped to handle both. The safety and maintenance of the new appliances by which light and heat and power are furnished have been suddenly thrown, as a new responsibility, on the craft of car-building.

"See how much higher is the demand that will be made upon you in the immediate future. When I say you, I include the journeymen car builders, forming that valuable recruiting arm from which men for important stations can be graduated. This great revolution in motive power will not only tax you, but every man down the line. Tracks, switches, roundhouses and repair shops will need, under these new conditions, men with considerably more than the rudimentary knowledge that has heretofore sufficed, and it is the duty of all of us to drive this truth home in order that it may be fully appreciated and that we may recognize the new necessity that is upon us.

"That there is a revolution going on, might be profitably insisted on with a slight note of alarm. Every other revolution that has taken place in railway equipment has been a gradual one, and men have had time to slowly adapt themselves to altered conditions. The basis has been all along practically the same, and the successive revolutions have been mere modifications and improvements along a given line. This is not the case with the present change. There is an absolute annihilation, not only of the present means of power, but the substitute for that power instead of being centralized and capable of isolation, is so associated with the rolling stock as to make it an integral part of it, to be given into your charge. There has been very little preparation for this change which adds to the requirements of your craft the elements of an art that none of us are any too familiar with.

"All your roads, and particularly the two great corporations that I have mentioned, as soon as they have installed electric traction in New York, will be handling in their shops these new hybrid combinations, which are neither all cars nor all locomotives, but something of both, and it will take more than an expert carpenter or blacksmith to keep them in order.

"The magnitude of the change is shown in tabulated form below, the total electric generating capacity located at New York being so divided as to show at a glance the amount in operation at the present moment and that contracted for for near future delivery.

	In Operation.		Contracted for.	
	K. W.	Equivalent H. P.	K. W.	Equivalent H. P.
Manhattan Ry.	48,000	72,000	6,000	9,000
Bklyn. El. lines	*20,000	30,000	....	....
Interboro. subway	....	....	48,000	72,000
L. I. R. R.	....	....	16,500	24,750
N. Y. C. R. R.	....	....	40,000	60,000
Total	68,000	102,000	110,500	165,750

*Estimated.

"It is proposed to substitute for steam on the Interborough, the Long Island and the New York Central, 156,750 horse-power units, or 54,750 units more than the Brooklyn elevated lines and the Manhattan Railway are at present developing. Within the next two or three years you are to have turned over to your care much of the machinery by means of which this tremendous volume of energy is to be transformed into work, for adjustment on the vehicles you make and repair.

"Academic and scientific men have done their work. Their problem has been solved; yours is yet to be. Into your keeping is to be handed over the adjustment and disposition of the machinery which the scientific men have invented and adapted, and on your efficiency depends the validity of the investment of millions of dollars and virtually the whole responsibility of reforming the method by which the most important part of the business of any civilized people—that of transportation—is conducted. There is to be made upon you, gentlemen, a sudden demand affording small opportunity for the gradual acquirement of efficiency. The demand must be answered at once, or the man failing to answer must inevitably fall back. I want to point out that what the situation needs is preliminary preparation, so that when the demand arises the men may be already equipped. The great necessity in all kinds of railroad work is preparedness. Slowly, year by year, with the enlargement of the necessities of a great businesslike transportation, its demand upon the individuals employed becomes more and more exacting. The burning question is 'Where can we get a man who can go into a carhouse and take care of the electrical equipment of a car?' He must be a combination man, for there can be no separation of forces.

"The displacement of the engine on suburban branches of steam roads will be absolute as from time to time electricity is developed and applied. There will be no change from the car builder's standpoint except the addition of the electro-mechanical principles of electrical operation which will come under his supervision. There will be no other special features of the work connected with the car other than the special electrical motor work which will go to the central machine shop. You must be prepared to take not only your car, but to take the intricate motive power and mechanical working parts of the car and care for it in the car shop and turn it out for service the following day."

President Brazier then addressed the Association. After commenting briefly on the progress in car building since the organization of the Master Car Builders' Association, he pointed out some of the unsolved problems in car work and suggested some possible lines of profitable investigation for the future. In part, he said:

"The expensive parts of freight and passenger equipment to maintain to-day are the draft rigging, couplers, uncoupling levers and running parts. One of the greatest expenses is maintaining so large a number of different makes of couplers, which each road is compelled to carry in stock, thus necessitating the carrying of many different kinds of knuckles and other parts of couplers to maintan cars running over its system. It would be desirable if all the roads could adopt one standard M. C. B. steel coupler, or have the number reduced to at least three or four makes. The whole subject of automatic couplers is so completely covered with over 8,000 patents that it would probably be exceedingly difficult to get up a new coupler that would be acceptable to a majority of the railroads without incurring much trouble and inconvenience due to these patents. I would suggest that a committee be appointed to report upon the desirability of having a coupler designed, if one is not already in existence, which our association could take as a standard; a coupler which would consist of the following parts: 1st, coupler body; 2d, knuckle, so designed that in the event of a knuckle pin breaking the knuckle will not pull out; 3d, a knuckle pin; 4th, a knuckle lock.

"I desire to call attention to the importance of a closer inspection of couplers and attachments to prevent break-in-twos of freight trains. Some roads have adopted the plan of having trains stretched at terminals and the couplers gaged with a small gage which can be handily carried by inspectors. In case this gage will slip in between the knuckle and the face of the coupler the car is set out and the trouble remedied. It is not always a worn knuckle that causes an uncoupling; sometimes other wearing parts become so worn that they allow the knuckle to open sufficiently to uncouple the train.

"The suggestion has been made that new couplers should have a bushing in the pin hole, so constructed that it can be removed when worn too large, and a new bushing applied or some means provided to take up the wear. In some new couplers it has been found the pin hole was from ⅛ to ¼ in. too large, and in some cases the pins too small. Knuckles received from manufacturers should be gaged to see that they are made according to the standard contour lines. Many knuckles on the market to-day are not standard to the make of coupler in which they are intended to be used. When two knuckles not made according to the M. C. B. contour lines are placed in adjacent couplers, trains will part without either of the knuckles opening. Consequently particular attention should be paid to see that all new knuckles are probably gaged when received. The coupler committee should also take up the question of coupler side clearance. With our long freight cars we should give more side play in our coupler yokes.

"There has been considerable discussion as to whether an 80,000 and 100,000 lbs. capacity box car is an economical vehicle of transportation for merchandise. The average lading of even our 60,000 lbs. capacity car is much less than its capacity, which would indicate that it is rather expensive to haul the additional weight of the larger cars. However, this its a question for the operating and traffic departments to determine, but there are features connected with it in which the car department is interested.

"Since the adoption of the rule providing for the per diem charge on freight cars there is no question but that the extent of repairs made to freight cars on foreign lines has greatly diminished, the tendency being to make only such repairs as are absolutely necessary to put the car in safe condition for movement over the road on which the repairs are made and get rid of the car as quickly as possible, in order to avoid the penalty prescribed by the per diem rule.

The result is that in neglecting to make some slight repairs to a car very extensive repairs are often necessary by the time the car reaches its home road. On the other hand when cars were handled on the mileage basis (there being no penalty for holding a car the requisite time in which to make the necessary repairs), more repairs for which owners were responsible were made and the cost thereof billed against the owners. While it is important that each railroad should release foreign cars which are held for repairs as promptly as possible, still many repairs are neglected which, if made at the time the defect is discovered, would possibly prevent subsequent damage and obviate the necessity of making heavier repairs.

"In all branches of mechanical activity there is great need for improving systems of apprenticeship. This is particularly true of car departments of railroads. Car builders have been rather remiss in this matter and it is exceedingly important that we should encourage young men of the right sort to become apprentices in car building and to properly provide such apprentice regulations as are necessary to attract young men of the kind we need. We have talked about apprenticeship for years; let us now do something.

"The Master Car Builders' and Master Mechanics' associations should be brought together as one organization. The work of the Master Mechanics' Association is largely educational, and as locomotives are not interchanged it has not the legislative function of the Master Car Builders' Association in the matter of interchange rules. It would seem that the interests of the two associations are not now sufficiently far apart to warrant maintaining separate organizations. Conventions may be arranged so that car and locomotive subjects will be grouped together and discussed at separate sessions, special days being set apart for the rules of interchange and other subjects specially pertaining to cars. The time for seriously considering this question has arrived."

The suggestions of the president may be summarized as follows:

1. The adoption of a standard coupler.
2. Standardizing the pivot pin and the material to be used in its manufacture.
3. Investigation of coupler side clearance.
4. A standard formula for journal bearings and linings.
5. Improvement in the quality of waste for use in freight and passenger service.
6. An addition to be made to the requirements of the standard brake beam, calling for test across line of fulcrum.
7. The standardization of steel freight cars.
8. The use of 40 and 50 ton capacity box cars, from an economical standpoint.
9. Improvements in uncoupling arrangements on couplers.
10. Adoption of standard archbar truck.
11. An adequate apprenticeship system.
12. The consolidation of the Master Car Builders' and Master Mechanics' associations.

The secretary's report showed a total present membership of 581, composed of 335 active, 217 representative, 10 associate and 19 life members. The total number of cars represented in the association is 1,755,682.

The report of the treasurer, John Kirby, showed a balance on hand on June 15, 1904, of $3,469.38.

The Executive Committee recommended that the annual dues be $4 per vote instead of $3, and this was approved by the association.

Mr. Appleyard (Pullman Company) read the committee report on standards and recommended practice. The discussion was on the individual recommendations of the committee and action was taken on each as it was read. The first subject considered was a standard length of brake beam and the recommendation that a committee be appointed to report on standard dimensions of brake beams was adopted. The suggestion that the standard diameter for knuckle pins be made 1⅝ in. was referred to the committee on couplers. Sections 2, 3, 4 and 5 of the committee report relating to limit gages for couplers and yoke and drawbar straps for couplers were referred to the proper standing committees. The suggestion that buffer blocks on freight cars be left off in the future was adopted after some discussion, several members being strongly in favor of retaining them as valuable aids in preventing undue slack in trains. A change in dimensions of the wheel defect gage was referred to the committee on wheels. The proposed adoption as standard of 1¼ in. bolts for 5 in. x 9 in. journal boxes was approved. The recommendation that a committee be appointed to prepare a design for a filled bearing for 5½ in. x 10 in. journals was approved, as was also the recommendation that a committee be appointed to prepare designs for standard arch-bars for 100,000 lb. trucks. A committee was authorized to prepare designs for a standard ladder for box cars and to determine upon the location of the ladder and also the handholds on the roof. Committees were ordered appointed to consider recommended practice for attachments of draft gear to steel cars, design of a flush car door to replace the present sliding door, and the location of airbrake parts on steel cars. The location of air pipes and angle cocks now embodied in the Recommended Practice was advanced to standard, subject to letter ballot. Safety chains for freight cars, the advisability of abandoning short draft sills, revision of the present design of twist gage for couplers, and changes in the drawings shown of the M. C. B. drop test machine, were all referred to the respective standing committees.

Mr. E. A. Moseley, secretary of the Interstate Commerce Commission, then addressed the convention. An abstract of his address was printed last week in the *Railroad Gazette*, p. 64.

The report of the committee on triple valve tests was included in the joint committee report on revision of air brake and signal instructions. The report was not read, but was referred to letter ballot for adoption.

The committee on brake shoe tests reported that no brake shoes had been submitted to it for test during the last year. Prof. W. F. M. Goss, Purdue University, a member of the committee, called attention to the inactivity of this important standing committee and suggested that it should again resume the investigations of brake shoe efficiency carried on some years ago. Mr. Garstang (Big Four) moved that any railroad using brake shoes which have not been previously tested, send a sample of the shoe to the committee with an analysis of the shoe's composition, and that the reports of such tests be submitted as the committee's report next year. The motion was carried.

The committee report on tests of M. C. B. couplers was read by Mr. Appleyard (see *Railroad Gazette*, June 24, p. 78). There was some discussion on the recommendation that there be 1-16 in. clearance between the knuckle pin and the hole, some of the members being of the opinion that this was too much. Mr. W. T. Bentley (B. & O.), agreed with the recommendation in the President's address that some form of pin hole bushing be used or that the hole be machined in order to reduce the lost motion at that point. The recommendations of the committee were ordered submitted to letter ballot.

The committee report on standard location of third rail was read, accepted and the committee discharged without further discussion. (See *Railroad Gazette*, June 24, p. 70.)

The committee on stenciling cars asked to be continued for another year, and made no report.

Mr. R. P. C. Sanderson (Seaboard Air Line) read the report of the committee on coupling chains (see *Railroad Gazette*, June 24, p. 69). Mr. R. L. Cline (P. R. R.), a member of the committee, presented a minority report. Mr. Sanderson called attention to the idea that seems to prevail that permanent safety chains will take the place of wrapping chains in double loads. The large amount of slack in the permanent safety chains will not permit cars to be properly blocked apart. Wrapping chains are essential for this purpose. With the permanent chains, if the couplers part, the two cars carrying a double load can move apart from 18 in. to 20 in., and this might cause serious disarrangement of the load. On motion, the committee was continued for another year, that it might make a unanimous report. The meeting then adjourned for the day.

SECOND DAY'S PROCEEDINGS.

The first order of business was the reading and discussion of the report of the committee on air brake hose specifications. Mr. Le Grand Parish (Ind., Ill. & Ia.), read the report by abstract. (See *Railroad Gazette*, June 24, p. 71.) Mr. A. M. Waitt moved that the committee be continued for another year, with instructions to carry out further tests at Purdue University, and that in the meantime the clause in the Rules of Interchange requiring all cars to be equipped with M. C. B. standard hose after July, 1905, be thrown out until the committee can frame a more satisfactory specification. The motion was carried. Mr. G. R. Henderson referred to the damage caused to hose by the machines used in mounting the nipples. An examination of several thousand hose after they had been removed showed that more than three-fourths of them had been damaged in forcing the nipples into the coupling, due largely to the rough and irregular shape of the fittings. Another cause of burst hose are the machines for stripping, some of which have a chisel to split the hose around the fitting. This chisel is often forced into the nipple and forms a sharp burr which cuts the lining when a new hose is applied.

Mr. Sanderson was of the opinion that the proposed requirements for trainmen going between cars and uncoupling hose on arrival of a train in yards, could not be enforced, because it would mean putting up a blue flag every time it was done, and this would congest traffic too greatly. He believed the pulling apart of hose could not be stopped altogether or even in great part. As a business proposition it would not pay the railroads to buy expensive hose when nearly 90 per cent. of hose removed was removed for causes not attributable to poor quality. Several others sustained his position on that point. It was finally agreed to abrogate the present M. C. B. standard recommendations and substitute, subject to letter ballot, the new specifications as recommended practice.

The committee report on draft gear was read by Mr. Parish (see *Railroad Gazette*, June 24, p. 72). Mr. Sanderson and Mr. Parish were both of the opinion that the round back yoke was a good design, but that perhaps better results could be obtained with a round back construction made of malle-

able iron in preference to using a wrought iron flat follower 1⅝ in. or 2¼ in. thick with a filling piece. Roads should have the option of using either form. Mr. Hennesey (C., M. & St. P.) was in favor of increasing the size of the yoke rivets from 1⅛ in. to 1⅜ in. in view of the many failures of draft gear at that point. He advocated doing away with the gibs or turned down ends that fit over the liner blocks and also widening the yoke from 4 in. to 4½ in. over the liner blocks. His recommendations were referred to the committee on standards. The report of the committee was accepted.

Mr. J. S. Chambers (Atlantic Coast Line) read the committe report on stake pockets (see *Railroad Gazette*, June 24, p. 73). Mr. Kiesel (P. R. R.) objected to using only ½ in. metal at the top of the pocket because it would be too weak. He also objected to the recommendation of 4 in. x 5 in. temporary stakes on the ground that the clearances for large numbers of cars now in service would not allow more than 4 in. x 4 in. stakes to be used. Mr. Ball (Lake Shore) suggested that a minimum instead of a maximum weight be specified, because the tendency was always in making malleable iron castings too light. The report was referred to the committee on standard.

Mr. H. S. Hayward (P. R. R.) read the report of the committee on prevention of rust on steel cars (see *Railroad Gazette*, June 24, p. 70). In presenting the report he explained that it was based largely on the recommendations of roads having large numbers of steel cars in service. On the Pennsylvania, coal tar placed between the joints had proved an excellent preservative. Most of the graphite paints used were mixed with linseed oil. Mr. W. T. Gorell (P. & R.) said that some time ago a car which had been in the shop had been thoroughly cleaned and coated with linseed oil. After three months' service it appeared to be in excellent condition, showing that the supposed cracking of linseed oil when dried out is not a serious defect. Mr. Sanderson (Seaboard Air Line) suggested the use of tar paper for protecting steel underframe, wood body cars from the effects of acid leaching through the load, the paper to be laid over and around the sills under the floor. Mr. McIntosh (C. R. R. of N. J.) thought the secret of success in painting steel cars lay in thoroughly painting the cars when new, and having a good foundation for successive coats. The report of the committee was accepted and placed on file.

The report of the arbitration committee was taken up next in order. Contrary to the usual custom, it was accepted without reading or discussing the several proposed changes. The decisions in the arbitration cases brought before the committee were formally approved by the association.

The committee report on prices for repairs to steel cars was read by abstract and opened for discussion (see *Railroad Gazette*, June 24, p. 69). Mr. Hennesey (C., M. & St. L.) suggested that the price for bodies of 80,000-lb. cars be fixed at $100 less than those of 100,000-lb. cars, but both Mr. Stark (Pitts. Coal Co.) and Mr. McIntosh thought this too much and that $30 less would be a fair valuation. Mr. W. T. Bentley (B. & O.) thought that the price recommended for scrap at ¾ cents per lb. was too much, and that ½ cent would be a fairer price. Mr. Mord Roberts (K. C. So. Ry.) spoke of the injustice to roads situated a long distance from the source of steel supplies which the rule regarding charges for material at market prices, presumably f.o.b. shipping point, would involve. Mr. Schroyer (C. & N. W.) thought this would involve but little hardship, as on his road the average annual cost of repairs to foreign steel cars was $1.62. The splice for center sills shown in a sketch in the report was severely criticised by several members as not being strong enough for the shocks it is required to resist. The committee was continued to submit another design next year. A committee of five was appointed to draw up a satisfactory set of interchange rules covering passenger equipment, on motion of Mr. H. F. Ball (Lake Shore) after Mr. J. T. Chamberlain (B. & M.) had read a communication from the New England Railroad Club.

The committee report on outside dimensions of box cars was read by Mr. Appleyard (see *Railroad Gazette*, June 24, p. 71). Mr. Sanderson questioned the possibility of running cars of the proposed dimensions through certain tunnels on the B. & O. and the Pennsylvania, but Mr. Appleyard stated that these roads had both approved the dimensions as satisfactory. The report was referred to letter ballot for adoption as recommended practice.

Mr. William Forsyth followed with an individual paper on steel for passenger car construction (see *Railroad Gazette*, June 24, p. 74). In introducing the subject he said:

"My object is to call attention to the increasing weight of passenger cars and the unequal distribution of strength in passenger trains. Twenty years ago passenger coaches weighed 50,000 lbs.; they now weigh 110,000 and 112,000 lbs. The weight has been more than doubled and the capacity has not been increased more than 30 per cent. Pullman cars now weigh as much as a passenger locomotive and tender weighed then. They have been increasing in weight at the rate of 5,000 lbs. a year for the last six or eight years. This great weight in passenger trains creates not only a big expense in hauling heavy passenger trains, but the weight prevents an increase in schedule time. The Master Car Builders should make some effort to prevent this constant increase in the weight of equipment. The use of steel would increase the safety of the equipment, without increasing the weights. It is usually claimed that, weight for weight, wood is as strong as iron, but when disposed in the form of a deep plate flanged girder with thin web, there is quite a difference in favor of steel as compared with the rectangular wooden beam."

Mr. G. R. Henderson suggested that a committee be appointed to consider not only a design of steel frame for passenger cars, but also a suitable and harmonious list of non-combustible interior and exterior trimmings. Mr. M. K. Barnum (C., R. I. & P.) thought that postal cars as well, should be considered, and that the association should take some action along this line before it was compelled to do so by the Government, which was seriously considering a safer construction of postal cars. Mr. F. H. Clark (C., B. & Q.) said that his road has a number of cars built with the Challender truss similar to the girder side frame proposed by Mr. Forsyth, and that a good deal of trouble had been experienced on account of corrosion. The plates are not easy to get at for inspection and painting, and rust eats them out rapidly. Mr. Ball suggested that the committee consider not only an all-steel design but should also prepare an alternative design with wood body and steel underframe. The committee was so instructed.

The report of the committee on cast-iron wheels elicited much discussion (see *Railroad Gazette*, June 24, p. 68). Mr. Garstang read the report and recommended that it be submitted to letter ballot for adoption as recommended practice. Mr. Hennessey objected to the clause requiring wheels for acceptance in interchange to weigh not less than 585, 635 and 685 lbs. for the three classes of cars respectively. Mr. McIntosh suggested that the clause be made to read so as to include only wheels cast after December 1, 1904. Mr. J. E. Muhlfeld (B. & O.) said that experience on that road had shown that the form of wheel proposed had not given as satisfactory service as some other designs. One in particular, which has given excellent results under hard service conditions, originated in the B. & O. foundry some 18 years ago, and it is a great improvement over the old M. C. B. standard. In the proposed design of wheel there are different stresses that tend to work against one another. In the design of wheel referred to there is a harmony and a unison in the contractive and expansive efforts. The proposed design of wheel would have a tread contour which is liable to create flange friction. Flange friction results in cracks at the throat of the flange and eventually in the breakage of the flange. The proposed wheel has an increased depth of the metal at the tread in order to relieve the chilling action at the flange, and it has not added strength at that point. The other design referred to has the advantage of backing up the flange with more metal; the tread is deepened at that point and tends to reduce the chilling action; and the plates are of such design as to prevent the cracking. While they have had cracked plates with that design of wheel, they have not had, in proportion to the number of wheels of the different types used, anywhere near the same number. Under severe service conditions on heavy grades and where heavy, severe braking power is required, and with heavy equipment it will sooner or later result in the condemnation of the cast-iron wheel. This seems to be the concensus of opinion on the Baltimore & Ohio from the practical results of the last ten years. The railroads to-day are not, however, in a position to increase operating expenses by adopting a very expensive wheel unless they are forced to. Mr. Fowler (Can. Pac.) said that on the Southern Pacific, where the curves and grades were probably as severe as anywhere in the country, they had used a design somewhat similar to the one mentioned by Mr. Muhlfeld, and that it had given poor service. They had then adopted a design similar to the proposed new design and obtained very satisfactory results. Mr. Whyte (B. & O.) did not see how the Association was justified in adopting the proposed wheel when for the last 18 months wheels of almost identical design had been giving so much trouble from the very causes which it was proposed to remedy. Mr. Garstang told of the committee's meeting with the wheel makers and of the final adoption of the proposed design as satisfactory to all concerned. He said he believed that the time for adopting a standard wheel was never so opportune as at present. Mr. Onderdonk (B. & O.) referred to a test started some years ago in order to determine the cause of the development of seams in the throat of cast-iron wheels. A number of wheels were put under 100,000 lb. cars, one truck having the regular brake applied and the other truck being free from brakes. This was to determine whether the seams were developed in the throats of the wheels where no brake shoes were applied. After being in service for between 18 months and two years, two or three of the wheels on which a brake shoe had never been applied developed these seams and broke. These were cars operated in the eastern end of the B. & O., where the curves are quite severe. Other wheels under heavy equipment that had not been operated on grades, but simply around curves, developed the same

seam. He had never found that seams are not directly due to braking. The cracking of the plates, however, is due to the heat from the brakes and expansion. This has been overcome to a certain extent by the design of the wheels. The wheel recommended by the wheel makers at the present time was, he thought, a wheel that is easy of manufacture; that is, a wheel that can be cast or molded more readily than some of the other wheels that have been found to give better service.

The committee's report consisting of drawings of wheels and specifications was ordered submitted to letter ballot for adoption as recommended practice.

Mr. J. J. Hennessey opened the first topical discussion on the advantages or disadvantages of a 2-in. main steam pipe with 1⅝-in. steam hose. Mr. Ball quoted a test made last winter on a 16-car train, which showed that it could be properly heated with 30 lbs. steam pressure if the 2-in. pipe was used, and that it required 80 lbs. pressure with the 1½-in. pipe. Practical tests in heating trains running over the road with 1⅝ coupling hose showed better results than had ever before been attained, despite the severity of the winter. The Lake Shore is equipping its trains as fast as possible with 2-in. pipe and 1⅝-in. hose. Mr. F. W. Chaffee (N. Y. C.) said that all the cars on that road had been equipped with 2-in. pipe and large hose, and the results were uniformly satisfactory. The hose coupling has a lock on it which is considered essential. The opinions of Mr. McIntosh and Mr. Schroyer were at variance with the other gentlemen. They could not see the advantage of using a 2-in. pipe when the 1½-in. pipe will carry off all the steam that can be spared from the engine. It is essential, of course, to have a straight, clear opening through all the pipes, fittings, hose and couplings throughout the train; otherwise trouble will occur with any size pipe which may be used. The consensus of opinion seemed to be that the larger pipe and hose were advantageous, and that their use should be encouraged.

Topical Discussions.

Mr. E. B. Gilbert opened the next topical discussion on the subject, "To what extent does friction draft gear reduce expenses for repairs, etc.?"

Friction draft gear does reduce repairs and expenses below that of spring draft gear, though it is difficult to obtain detailed statistics showing the actual relations between the two. The points to be considered in comparing the two are:

First. The cost of repairs to the draft gear itself, taking into consideration the original prices of the two gears.

Second. Cost of repairs to couplers, yokes, draft lugs, draft sills, end sills and other adjacent parts which depend largely upon the draft gear.

Third. Expenses connected with switching and operating cars on road.

On the B. & L. E., which has heavy grades, the actual cost of repairs to friction draft gear on 6,800 steel cars of 100,000 lbs. capacity, purchased at various times from 1897 to the present, has been 4¼ cents per car per year. We are unable to find anything giving the cost of maintaining spring gear on a similar car, but from our experience with wooden cars it must be considerably greater.

Considering the cost of repairs to couplers, yokes, etc., records were kept by two connecting western railroads for a period of a year of all their coupler failures on two series of 100,000 lb. capacity steel cars, built exactly alike with the exception of the draft gear, one series being equipped with a friction gear and the other with a twin spring gear. The ratio was all in favor of the friction gear, as follows:

Coupler failures—car mile per failure... 4.8 to 1
Knuckle failures—car mile per failure..26.2 to 1
Yoke failures—car mile per failure......61.1 to 1

According to statistics which have been compiled, over 30 per cent. of the cost of maintaining freight cars is due to repairs to draft rigging and adjacent parts. With less repairs to make we save not only the cost of the repairs but we keep the cars in service, a matter of vital importance to the transportation department.

In these days, when the great problem is to keep the freight moving, yard men in drilling cars and making up trains, in order to save time, keep the cars moving at higher speeds and bring them together with greater force in order to expedite handling and insure coupling. In order to be able to do this and save the time, we should have a draft gear that will absorb considerable energy in itself. From the report of tests of the 1902 committee on draft gear, the best test of spring gear showed the total work absorbed to be 6,852 ft. pounds, while on the best test of friction gear the work absorbed was 18,399 ft. pounds, 90 per cent of this being absorbed by friction. This cannot help but keep down repairs when you can absorb this large amount of energy which otherwise would result in broken draft sills, etc.

High capacity spring gear has great recoil, giving back a large percentage of the blow it receives. This damages the cars and often causes break-in-twos, with their disastrous results.

In double spring gears with a maximum capacity of 40,000 lbs., the recoil is 16,000 lbs., while in friction draft gear a force of from 150,000 to 175,000 lbs. is required to compress the draft gear solid, yet the reaction is less than 7,000 lbs. It cannot be emphasized too strongly the possibility of preventing break-in-twos by the use of the friction gear, the attendant results of such breaks being well known.

On one of our allied roads two 167-ton locomotives were equipped with spring gear, which required repairs about every 10 weeks, the cost averaging 83 cents per thousand miles. Subsequently, friction gear was applied and no repairs were made for over 15 months.

The topical discussion, "To what extent will a more rigid inspection of car couplers at terminal points reduce accidents and repairs?" was opened by Mr. James Macbeth (N. Y. C.), as follows:

In view of the large number of break-in-twos of trains, it would appear imperative to arrange for close inspection of couplers and attachments not only at large terminals, but at all points where inspectors are located and where it is found possible to do so.

On one road they have been averaging about 50 break-in-twos on freight trains per month, which were directly traceable to worn coupler parts; fully 60 per cent. being due to worn couplers or knuckles, the balance being due to worn knuckle locks, lock pins and knuckle pins. In order to overcome this trouble some roads have adopted the practice of stretching trains before detaching the engines, i. e., setting brakes on a few rear cars, then taking out all the slack and setting the brakes on several cars at the head end, thereby leaving all the strain on the couplers and giving inspectors an opportunity to gage them with a small gage provided for that purpose. This gage is constructed upon the basis of the M. C. B. limits and can be handily carried by inspectors in their pockets. If the gage will slip in between the knuckle and face of coupler, the cars are parted and a close examination is made to ascertain the part at fault and either remedy the trouble on the spot, or if it is found impracticable to make the opening in the train, condemn the car to the repair track. This practice undoubtedly has a beneficial effect in reducing the number of break-in-twos and consequent damage to cars.

Mr. W. E. Fowler said that on the Canadian Pacific they had been using as a substitute for this gage, a straight flat piece of steel 5¼ in. long and ⅞ in. wide, which the inspector could easily slip into his pocket. If necessary, he was in favor of taking the radical step of increasing the labor charge for knuckle renewals, so as to force owners to keep the couplers up to standard. Mr. McIntosh said he had experimented to some extent with bushings placed in the coupler head around the knuckle pin on passenger equipment and the results had been so satisfactory that he contemplated trying the same remedy on freight equipment.

The topic, "The advantages and disadvantages of the different varieties of side bearings now in use," was opened by a contribution from Mr. L. H. Turner (P. & L. E.), as follows:

"Fully one-half of the wheels removed from under cars are taken out for sharp flanges, due entirely to improper construction and failure to use devices that will remove in a great degree, side rail wear. Reduction of train resistance presents greater possibilities in reducing cost of train movement than any other factor, and the construction of body bolsters and trucks can be so improved as to admit of a greater train load with higher rate of speed, less consumption of fuel, at no increase of locomotive energy, or, in other words, an application of power where it belongs, to the movement of freight and not consumed in needlessly wearing out wheel flanges and rails. Build the body bolsters of such material and strength as will enable them to carry the load upon the center bearing; and make the center plates so as to offer the least possible resistance to the rotative movement of the truck. Give side bearings of whatever type used sufficient clearance so as to not come in contact except on curves with high elevation. A dynamometer test, with a train with trucks and bolsters arranged and constructed as recommended, will show startling results in comparison with one as usually found with weak bolsters with one-half or more often nearly the whole of the load carried upon side bearings. There are no advantages in using side bearings, when considered alone, except that they support the side of the car, which the poor and improperly designed body bolster fails to do, and for this purpose one type is as good as another. The disadvantages are numerous. The greatest is the increased cost without corresponding benefits. We are striving to correct evils with wrong remedies. Patented devices have come into the market without number and none have accomplished what was claimed for them, and none will until center plates receive intelligent attention. When this is done the cost for transportation per ton mile will be greatly reduced, due to increased train tonnage per unit of power, trains will be moved faster, with an all-round improvement in service. Frictionless side bearings with frictionless center plates, or as nearly so as can be made, in connection with properly constructed body bolsters, are sorely needed. Mr. George L. Fowler gave some results of an interesting experiment made some time ago to determine the cause of unequal wear on curves.

Mr. Gorrell (P. & R.) opened the discussion on the present method of securing spring

pockets to couplers on freight cars. Mr. Ball suggested that possibly some form of pocket and attachment could be devised that could be removed from broken couplers and reapplied to new couplers at any small interchange or repair point with the labor at hand. He also thought that with the long pockets used in connection with friction draft gears, some form of flexible connection between the coupler and spring pocket would be advisable. He showed a drawing of such a connection in which the coupler is made with an enlarged end at the rear of the shank, which will take a 2½-in. pin. The coupler is also provided with a bushing. The pocket is made of 1-in. x 5-in. iron with the ends upset to form a circular lug concentric with the center of the pin. This gives additional bearing surface for wear. The M. C. B. pocket has 100 per cent. strength through the rivets; this design has 125 per cent. through the pin hole and 116 per cent. through the pin for resisting shear. With this form of pocket the coupler could be detached at any small repair point and a new one easily applied. The design also permits of greater lateral motion of the coupler, a very important consideration. On motion of Mr. F. H. Stark, the subject was referred to a committee for report next year.

Mr. W. E. Fowler opened the discussion on brake-beams and the proper method of hanging them to secure brake-shoe clearance. At least one-half of all the brake-shoes on most of the freight trains on this continent drag on the wheels when the cars are in motion. The retarding effect of this, or the additional power required to overcome the necessary friction, has been estimated to be as high as 5 per cent. No relief has so far appeared for brakes when hung to the body, and none that is practical and effectual when hung to the trucks. The only proper place for attachment of the brake hanger is to the truck, and to that part of it not affected by spring movement, this being necessary to secure uniform piston travel and braking power. Inner hung brakes applied in this way are, however, almost, if not always, so hung that the top (if not all) of the brake-shoe drags on the wheel, creating friction, which is costly, both in brake-shoes and power. The trussed brake-beam, unless supported at the lower fulcrum by a suspension spring or hanger, will produce friction, as will attachment of hanger too low on the brake head, a brake hanger too nearly vertical, a brake lever fulcrum which carries the lever too far forward, a bottom connection too short, etc. The suspension spring at the fulcrum, a bottom rod of proper length, a truck wheel base long enough to permit brake hanger to assume an angle of about 110 deg. with a line drawn through the center of the brake head and center of the wheel—all these are factors in the problem. The suspension spring is neither durable nor reliable, and it adds considerably to the cost of the truck. The brake head should be so re-designed that with a wheel base of 5 ft. 3 in. or 5 ft. 4 in., and brake-beam center 14 in. from top of rail, the contour of the face of the brake-shoe will coincide with the section of the wheel tread presented to it, and the angle of the brake hanger should be sufficient to withdraw the brake-shoe from the wheel evenly—top and bottom—when brakes are released. It would also be well to have the brake hanger as long as possible, so that the difference in position of brake levers, caused by wear of shoes, would have the minimum effect on the hanging of the shoe.

Tests made indicate that a reliable release spring requires to overcome it a pressure as great as 10 lbs. per sq. in. in the cylinder, and as it also requires more attention than it is likely to receive in the way of adjustment, we should look for a way of overcoming the difficulty by gravity. Mr. G. R. Henderson pointed out that when retardation due to braking takes place the weight is thrown on the forward wheel of the truck, and the weight is decreased on the rear wheel. If the hangers are placed inside, the effect of the angle of the hanger will be to reduce the braking power on the rear wheel, which has the weight decreased, and to increase it on the front wheel, which has the increased weight, so that the full benefit of the brakes is had without slipping. If, however, the brakes are hung outside, then the angle of the hanger tends to effect an increased braking power on the rear wheel, which has the diminished weight, and to reduce the braking power of the front wheel, which has the increased weight. In order to prevent wheels from slipping a smaller co-efficient must be used for braking if brakes are outside hung than if they are inside hung.

Mr. J. J. Hennessey was of the opinion that theoretically the correct position for a brake is inside and hung from the spring plank or some part of the truck that does not vary in height, yet a brake that is not relieved at all by the spring is shut out of good working action so very often that in practice it becomes a serious matter to hang a brake where it is not relieved by the spring, either inside or outside. There would be little trouble with outside hung brakes if a hanger long enough was hung at such an angle that as soon as the brakes are released it would draw the shoe off and not drag on the front end.

Mr. Fowler in reply said that inside-hung brakes are hung to parts of the truck not affected by the truck spring movements and that this insured uniform piston travel in the brake system under all conditions. This is one of the most important points in connection with the subject.

The next topic, "Stronger Draft Gear for Passenger Cars," was opened by Mr. H. La Rue (C., R. I. & P.). He said that two years ago they began to strengthen the draft arrangement on certain classes of equipment with the wooden draft timbers. A tandem arrangement was not used for the reason that very often this equipment was placed in a three or five car train and the draft springs were too stiff. The main trouble was to hold the draft lugs to the timbers and keep them from splitting.

A special casting was designed, which has been applied on all old cars brought into the shop for over a year and they have never had to renew one for any cause. The casting is made in two parts and is securely blocked between the horn on the front of the casting and the end sill; also it is securely blocked between the back of the casting and the body transom. This arrangement has been applied to use on all classes of cars with wooden draft timbers without changing the standard extension of the drawbars and has given excellent results.

About three years ago they increased the standard draft arrangement under the heavier equipment that have steel platforms, by making the spring follower 1⅝ in. thick and the distance between the pulling lugs or draft beams 11 in., but still using the standard 6 in. x 8 in. draft spring.

Some companies are using the tandem springs, but in most cases this necessitates different lengths of drawbars to suit the different equipment, possibly making two or three different lengths, which is a very serious objection upon a large system on account of the large stock carried at so many different points.

The ideal arrangement should operate so that the first ¾ in. of the travel of the drawbar should be comparatively easy or about the same as the present 8-in. spring. The balance of the travel should go up in strength very quickly and much stronger, to suit both light and heavy trains, and also the space occupied by such an arrangement should be but a very little more than the present single spring arrangement, so that the same length of drawbar can be maintained on all classes of cars. Mr. E. M. Herr (Westinghouse A. B. Co.) said that greater yielding resistance is rather difficult to obtain in the very limited space available. It is exceedingly difficult to bring in yielding resistances without having considerable space. In order to absorb the energy which must be done in the starting, you must have space in which to do it. He doubted very much if any successful device could be arranged that would only occupy 8 in.

Mr. G. R. Henderson—The subject of tandem springs in passenger equipment is important. It was referred to by the speaker as not being entirely satisfactory. The last road I was connected with hauled heavy trains, up to 15 and 18 cars, and we found with the single springs that it was impossible to keep the platforms together, and they would stand apart as much as 2 inches. We adopted the policy of placing two springs —tandem springs—and we found quite a benefit in reducing the shock.

Mr. La Rue—What I had reference to as the tandem spring not being entirely satisfactory was in the length of space occupied. My object in bringing this matter up was to stimulate some one to devise an arrangement steady enough to do the work to occupy a space of about 17 inches. If it cannot be brought inside these figures, as I stated before, it will necessitate different lengths of extensions of the drawbars, and that is something we would rather not go to, unless it is absolutely impossible to get something which will answer the purpose. I realize that the tandem spring would be satisfactory for the baggage cars, and such as that, and I believe it would be all right for the forward cars, but I do not think it is right for all coaches, because I think there is too much resistance in the spring.

Mr. J. J. Hennessey (C., M. & St. P.) thought the ideal passenger car spring or attachment should be constructed for an ordinary spring, and that possibly the M. C. B. spring of the present strength could be used. Give that an opportunity to yield 1½ in. and then have a friction come in that would take the severe shocks. The friction would not act at all except when the jerks or the shocks are more than are usually found in ordinary service. The objection to large spring power is that a recoil that is very objectionable cannot be avoided.

Mr. La Rue said his idea in venturing the suggestion that the first ¾ of an inch would be the ordinary spring was on account of the switching of the passenger cars and throwing them together at the present time with the knuckles closed, and also to give the ordinary spring resistance with the 1¼-in. movement that is had on the buffers at the present time on passenger equipment. After that was absorbed then the power should all come in the next inch, running up on the car to a resistance of probably 50,000, 55,000 or 60,000 lbs.

Mr. Herr said there is no difficulty whatever in obtaining exactly what was described in existing friction gears, but not in the

small space. It would require more than 8 in. of space in which to put it.

The meeting then adjourned.

THIRD DAY'S PROCEEDINGS.

The first business of the third session was the supplementary report of the Arbitration Committee on the questions submitted to it for action during the two previous sessions. The committee reported against placing a minimum weight on wheels for acceptance in interchange; fixed the price for 40-ton box car bodies with wooden bodies and steel underframes when 36 ft. long and under 40 ft. at $675; approved the suggestions of the committee on prices of repairs to steel cars in all their important points except the price of ¾ cent for scrap credits, which was recommended to be changed to ½ cent. The supplementary report was adopted without discussion and the convention proceeded to the report of the committee on loading long materials. After much discussion, especially on the recommendation that ties and fence posts loaded on flat cars be not accepted for shipment, the report was ordered referred to letter ballot for action on each rule. A standing committee was ordered to be appointed to take up this question each year.

The next report was on steam and air line connections. The committee was unable to make anything but a progress report and asked to be continued another year. The report of the committee on subjects was received and adopted. (See *Railroad Gazette*, June 24, p. 68.) Mr. C. M. Bloxham read the report of the committee on tank cars and Mr. A. W. Gibbs asked that it be received as a progress report and the committee continued another year. The American Railway Association will not take definite action on the subject of rules for tank car movements in trains until next fall and the committee has still a number of important tests to make before any definite action is taken looking toward a standard. The committee was continued. After hearing the report of the committee on resolutions and the nominating committee the annual election took place. The following officers were elected for the coming year: President, W. P. Appleyard (The Pullman Company); 1st Vice-President, Joseph E. Buker (Illinois Central); 2d Vice-President, W. E. Fowler (Canadian Pacific); 3d Vice-President, George N. Dow (Lake Shore); Treasurer, John Kirby. The executive committee for the coming year is composed of James Macbeth (N. Y. C.), A. E. Mitchell (Lehigh Valley), H. D. Taylor.

The retiring president and incoming president made suitable speeches and after Mr. Appleyard took the chair the meeting adjourned.

Additional Exhibits at Saratoga.

The following list of exhibits at the Saratoga Conventions completes the partial list printed last week, p. 79:

American Balance Valve Co., Jersey Shore, Pa.—American balanced slide valves, American balanced piston valves, the J. T. Wilson high-pressure balanced valve, American metallic piston rod and valve stem packing, Nixon safety stay-bolt sleeve.

American Machinery Co., Grand Rapids, Mich.—Oliver woodworking tools, wood trimmers, hand jointers, saw benches, band saws, wood lathes and pattern shop tools.

American Nut & Bolt Fastener Co., Pittsburg, Pa.—Samples of nut locks and bolt fasteners.

American Steel Foundries, New York.—The "R. E. Janney" cast-steel coupler.

American Stoker Co., Erie, Pa.—Model of a reverberatory furnace with stoker attachment and a stoker forge stand.

Andrew Ventilator Company, New York—Showing car ventilator.

Ashton Valve Co., Boston, Mass.—Exhibit in a room at the Grand Union Hotel of locomotive muffler and pop safety valves, blow-off valves, air and steam gages, gage testers and chime whistles.

Aurora Metal Co., Aurora, Ill.—Samples of the Lewis & Kunzer metallic piston packing.

Baltimore Railway Specialty Co., Baltimore, Md.—Norwood ball-bearing center-plates and side bearings.

Barnett Equipment Co., Newark, N. J.—The Barnett connector for automatically coupling the steam, air and signal pipe lines between cars.

Beard, Andrew J., Birmingham, Ala.—The Beard coupler.

Berlin Machine Co., Beloit, Wis.—Photographs and drawings of woodworking machinery.

Charles H. Besly & Co., Chicago, Ill.—Gardner grinding machines, taps, parallel clamps, spiral grooves.

Best International Calorific Company, Los Angeles, Cal.—Showing locomotive, stationary and blacksmith furnace burners.

Herman Boker & Co., New York.—Samples of "Novo" steel twist drills, cutters and other tools.

L. J. Bordo Co., Philadelphia, Pa.—The Bordo blow-off valve and Bordo swing joints.

Buchanan, Dr. A. T., Chicago, Ill.—Showing the Fay Manilla Roofing Company's insulating paper.

Cambria Steel Co., Johnstown, Pa.—Exhibit of locomotive forgings and two steel cars placed on the D. & H. tracks.

Camel Co., Chicago, Ill.—Hose clamps and car doors.

Car Builders' Supply Co., Chicago, Ill.—McIntosh ventilated hatch cover, freight and passenger car side bearings, oil box.

The Philip Carey Manufacturing Co., Lockland, Ohio.—Samples of 85 per cent. magnesia locomotive lagging and steam pipe covering.

J. M. Carpenter Tap & Die Co., Pawtucket, R. I.—Exhibit of taps, dies and other small tools.

Case Manufacturing Co., Columbus, Ohio.—Crane trolleys, electric hoists and controlling apparatus for crane motors.

Chicago Railway Equipment Co., Chicago, Ill.—"Creco" automatic frictionless side bearing, "Diamond" special brake-beam for high-speed brakes, "Diamond" adjustable brake-beam.

Cling-Surface Mfg. Co., Buffalo, N. Y.—Samples of belt dressing.

Coburn Trolley Track Mfg. Co., Holyoke, Mass.—Exhibit of overhead trolley track with traveler and hoist fitted with an automatic hoisting rope lock.

Columbus Steel Rolling Shutter Co., Columbus, Ohio.—Samples of steel rolling shutters.

Corkery Door Hanger Co., East Cambridge, Mass.—Model of car door hung on Corkery door hangers.

Corrington Air Brake Co., Matteawan, N. Y.—Air brake equipment for engines and cars and the Corrington alternate-continuous brake system apparatus.

Crandall Packing Co., Palmyra, N. Y.—Samples of steam, air and hydraulic packings.

Creasor, J. H., Wabigoon, Canada.—Showing the Creasor roller bearings.

Curtain Supply Co., Chicago, Ill.—Attractive booth fitted with several styles of car curtains with Burrowes and Forsyth "Roller Tip" fixtures.

Damascus Brake Beam Co., St. Louis, Mo.—Damascus brake-beams.

Davis Expansion Boring Tool Co., St. Louis, Mo.—Davis expansion car wheel boring tools.

Detroit Lubricator Co., Detroit, Mich.—Exhibit of several sizes of locomotive sight-feed lubricators of the original "bull's-eye" type.

The J. Dixon Crucible Co., Jersey City, N. J.—Samples of Dixon graphite paints and lubricants.

Dressel Railway Lamp Works, New York.—Locomotive headlights, signal lamps.

G. Drouvé Co., Bridgeport, Conn.—Models of the Lovell window operating device for shops and other buildings.

Economy Locomotive Sander Co., Baltimore, Md.—Exhibit of locomotive sanding devices.

Edgar Car Lock & Seal Co., Kansas City, Mo.—Car locks and seals for refrigerator car doors and sliding doors.

The Electric Storage Battery Co., Philadelphia, Pa.—Chloride accumulator storage batteries for train lighting.

Empire Safety Tread Co., Brooklyn, N. Y.—Samples of carborundum safety treads for car steps.

The Fairbanks Co., New York.—A large exhibit of gas engines, valves, scales, trucks, pumps, leather belting, Dart unions and flanges, power hacksaws, power hammers, copy presses, pipe-threading machines and other miscellaneous railroad tools and appliances.

Federal Co., Chicago, Ill.—Railroad water closets and toilet fixtures.

Flannery Bolt Co., Pittsburg, Pa.—Tate flexible stay-bolts.

Garlock Packing Co., Palmyra, N. Y.—A full line of air, steam and hydraulic hose, packings and rubber goods, including the Garlock throttle and air-pump packings.

General Manifold Co., Franklin, Pa.—Samples of manifold sheets, requisition blanks, defect cards, etc.

Goldschmidt Thermit Co., New York.—Samples of pieces welded by the Alumino-Thermic process.

Goodwin Car Co., New York.—Catalogues and photographs of the Goodwin dump car.

A. Morris Hall, Philadelphia, Pa.—Drop forgings made by the Transue & Williams Co., Alliance, Ohio, including car and locomotive forgings, ball-bearing center-plates, Buckeye track jacks, drop-forged keys and wedges.

Hall Signal Co., New York.—A two-blade electro-gas signal in operation and illuminated by the Commercial Acetylene Co.'s system.

Hanlon Locomotive Sander Co., Winchester, Mass.—Working model of locomotive sander.

Harris Manufacturing Co., Greenville, S. C.—Showing a train signal device operated through an independent line of ¾-in. pipe.

Harrison Dust Guard Co., Toledo, Ohio.—Exhibit of four sizes of Harrison dust guards for 20, 30, 40 and 50-ton cars; also a car journal lubricator.

N. L. Hayden Mfg. Co., Columbus, Ohio.—Samples of Downing metallic packing, Tippet locomotive safety valve and Hercules malleable pop safety valve.

Helwig Manufacturing Co., St. Paul, Minn.—Pneumatic tools.

Hill, Clarke & Co., Boston, Mass.—One No. 2 plain milling machine, one No. 2 Universal milling machine, one No. 2 Lucas boring machine, one 4-ft. Western radial drill, one 24-in. wet tool grinder, motor driven.

Hess-Bright Mfg. Co., Philadelphia, Pa.—Exhibit of ball bearings.

Hoffman Grain Door Co., Battle Creek, Mich.—Model of the Hoffman grain door.

Home Rubber Co., Trenton, N. J.—Samples of "N. B. O." packing, sheet packing and steam and air hose.

Industrial Water Co., New York.—Full size model of a chemical regulating device for a water-softening machine in operation.

International Text-Book Co., Scranton, Pa.—Complete sets of the "Library of Technology," electrical and mechanical engineering courses and law course and one of their instruction cars on the D. & H. tracks.

Jenkins Bros., New York.—Full line of angle and globe valves for high and low pressures and samples of Jenkins' "96" packing.

Kennicott Water Softener Company, The, Chicago, Ill.—Showing water-softening apparatus.

Keystone Drop Forge Works, Philadelphia, Pa.—Drop forgings for car and locomotive work, including Keystone connecting links, safety shackle hooks and crocodile wrenches.

Kindl Car Truck Co., Chicago, Ill.—Models of Kindl and Cloud trucks.

Locomotive Fuel Saving Company, New York.—Catalogues, records and photographs of fuel-saving device.

McGuire, Cummings Mfg. Co., Chicago, Ill.—A model of a new grain door with safety door brackets.

Mann, McCann Co., Chicago.—The Bruyn smoke jack, Northwestern locomotive air sander, McCann grader and spreader car, the Young locomotive valve gear, the Ravlin system of electric wiring for roundhouses and shops.

Manufacturers' Railway Supply Co., Chicago, Ill.—Plain and pocket faced interlocking brake shoes for cars and locomotives, samples of shoes taken direct from service from several large roads. Display showing difference between amount of scrap from Interlocking and other types of brake-shoes. Brake-beams for demonstrating the application and working of the shoes.

Modern Tool Co., Erie, Pa.—"Magic" chucks, self-opening dies, taps, mills, grinders and Wallace chaser.

Monarch Supply Co., Chicago, Ill.—Roller side bearing.

Moran Flexible Joint Co., Louisville, Ky.—Moran flexible joints for steam and air connections between engine and tender.

Nathan Mfg. Co., New York.—Exhibit of injectors, lubricators and Klinger reflex water glass.

Nernst Lamp Company, The, Pittsburg, Pa.—Showing the Nernst lamp, in the Westinghouse joint exhibit.

New Jersey Tube Co., Newark, N. J.—Cor-

rugated boiler tubes and a hydraulic machine for testing their expansion.

Page Car Company, Winterport, Me.—Models of dumping cars.

Peck, Stow & Wilcox Company, New York.—Wrenches, braces and chisels.

Peckham Manufacturing Company, The, New York.—Taylor non-chattering brake hanger, photographs and blue prints of electric and steam railroad trucks.

Philadelphia Pneumatic Tool Co., Philadelphia, Pa.—Chipping, calking and riveting hammers, yoke riveters, rotary drills, breast drills, foundry rammers, air hoists and complete pneumatic equipments; also a Herron & Bury compressor.

Post & Co., E. L., New York.—Post "Zero" metal for car and locomotive bearings.

Pyle-National Electric Headlight Co., Chicago, Ill.—See exhibit of Commercial Acetylene Co.

Railway Appliances Co., Chicago, Ill.—Oldsmobile railroad inspection car.

Rostand Manufacturing Company, New Haven, Conn.—Model of extension hat and bag rack for passenger coaches.

Schoen Steel Wheel Co., Pittsburg, Pa.—Exhibit of Schoen solid rolled and forged steel wheels.

Charles R. Silkman, New York.—An exhibit of samples of "Pluviusin," an artificial leather.

Smart Car Door Co., Nashua, N. H.—Model of Smart flush car door.

Spiral Journal Bearing Co., New York.—Exhibit of new and worn journal bearings.

Standard Brazing Co., Boston, Mass.—Brazing process.

Standard Paint Co., New York.—Refrigerator car models showing insulation sheeting and insulating paper, iron and wood preservative paint, car flooring and "Ruberoid" roofing.

The Standard Steel Works, Philadelphia, Pa.—The Standard rolled steel wheel.

Stannard & White, Racine, Wis.—Exhibit of locomotive cab seats.

Star Brass Manufacturing Co., Boston, Mass.—Steam gages, pop safety valves, lubricators, renewable seat and disc globe valves, angle valves, blow-off cocks, water gages, recording gages patent cylinder relief and vacuum valves.

Templeton, Kenly & Co., Ltd., Chicago, Ill.—Simplex jacks.

Trammell, E. R., Lakeland, Fla.—Safety device for holding up drawheads where pulled out.

Underwood, H. B., Philadelphia, Pa.—Catalogue of special tools, boring bars and valve seat facers, and a quartering level.

Washburn Company, The, Minneapolis, Minn.—Freight couplers, flexible head passenger couplers and switch engine couplers.

Watters, J. H., Augusta, Ga.—Automatic pneumatic track sanders.

Waugh Draft Gear Company, Chicago.—Full size model of spring cushion draft gear.

Wellman-Seaver-Morgan Co., Cleveland, Ohio. The Wellman-Street cast-steel bolsters.

Wheel Truing Brake Shoe Co., Detroit, Mich.—Samples of wheel truing brake shoes.

J. T. Williams & Sons, New York.—Exhibit of fancy woods for interior finish and decoration of cars.

Performance of Automatic Signals Under Unfavorable Conditions.*

BY H. S. BALLIET.

IV.—Batteries and Their Enclosures.

The gravity cell is the most common type of battery in use for working track circuits, being best adapted to heavy discharges and frequent short circuits. Generally speaking, two such cells are placed in multiple; this is done in order to keep the voltage as low as is practicable (about one volt being available). This arrangement of cells is considered necessary in order to avoid the possibility of failure to operate the relay in case one jar breaks.

This cell is easily maintained, it being necessary to renew the sulphate of copper about once every four weeks. A 4-lb. zinc of good quality will wear three months. These zincs should not be used after they are worn thin; for the internal resistance of the cell is then increased and in case of heavy rain or poor track insulation from any cause there are likely to be numerous interruptions, due to the insufficient voltage. Practice indicates that no zinc should be kept in service for a track circuit if it weighs one pound or less.

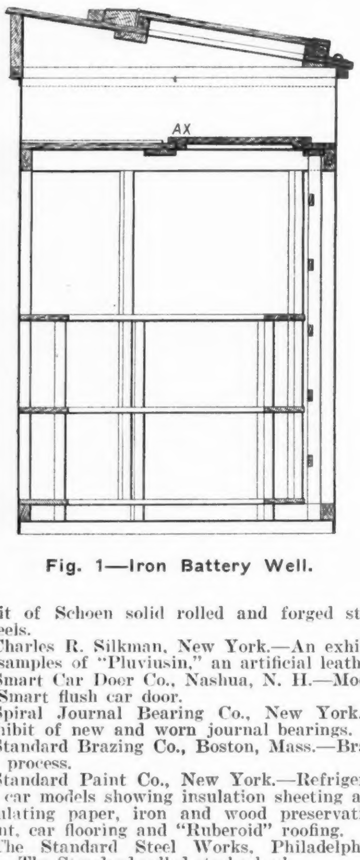


Fig. 1—Iron Battery Well.

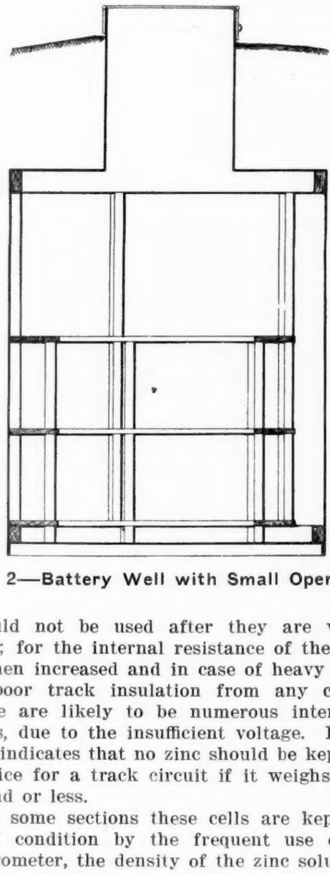


Fig. 2—Battery Well with Small Opening.

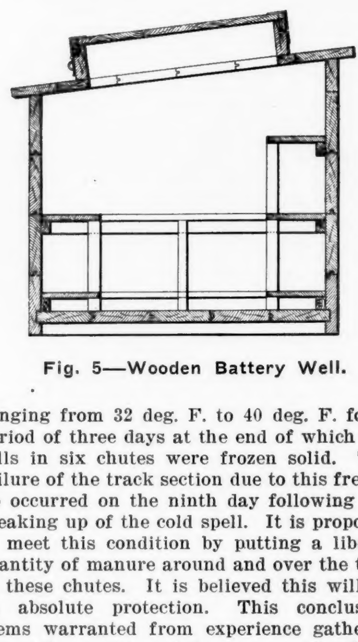


Fig. 5—Wooden Battery Well.

In some sections these cells are kept in good condition by the frequent use of a hydrometer, the density of the zinc solution being maintained at a specific gravity not to exceed 1.15, which is equivalent to about 24 per cent. of zinc sulphate plus 7 molecules of water. While this may work out to a nicety, a better way is to adopt stated periods for renewing the cells, say, once in four weeks, if the traffic is reasonably heavy and once in six weeks if it is not over 30 train movements in 24 hours. It can be said, however, that when working under such conditions cells should be inspected at least once between renewals. If there is too much zinc solution it should be diluted with water. Care should be taken to thoroughly screen and wash all sulphate of copper in a cell when it is renewed, also to remove all collections of copper so as to discourage the so-called "caking." Zincs should be kept scrupulously clean, so that there may be free action. This battery, being made of a solution of sulphate of copper, freezes when the temperature falls below 32 deg. F. To anticipate this condition, the cells are kept in iron pipes called "chutes," set in the ground, which brings the lowest cell about 7 ft. below the surface; deep wooden wells are also used and sometimes surface battery houses. With these precautions, generally speaking, there have been no interruptions to the continual flow of current, but the last winter made new disclosures, and it will be necessary to try new preventives.

A number of gravity cells were frozen for the first time because frost penetrated the earth farther than ever before—from six to eight feet. These conditions have been met successfully by using a liberal amount of mineral wool about 10 in. thick around the chute for a depth of four feet. One very trying case of frozen track battery was that where the temperature remained at from 28 deg. F. to 32 deg. F. below zero for several days. It was impossible to keep the circuits in service without the aid of heat, which was supplied by putting kerosene lamps within the chutes. In another instance the thermometer registered from 10 deg. F. to 20 deg. F. below zero for a period of ten days, the frost penetrating to a depth of five feet. This cold spell was followed by a rising temperature for a period of three days, the thermometer on the third day reaching 50 deg. F.; then there was a steady thermometer ranging from 32 deg. F. to 40 deg. F. for a period of three days at the end of which the cells in six chutes were frozen solid. The failure of the track section due to this freeze-up occurred on the ninth day following the breaking up of the cold spell. It is proposed to meet this condition by putting a liberal quantity of manure around and over the tops of these chutes. It is believed this will be an absolute protection. This conclusion seems warranted from experience gathered on another section of the same road, where under parallel conditions, the cells worked without interruption, having been protected by piling manure around iron battery wells in which were cells of several different designs. In the case of the six chutes frozen, it is known that the earth was not closely packed when the chutes were set.

The gravity cell is also used for operating signal magnets, clutches and locks. When used for this purpose, the cell need not have so close inspection as when it is used for track circuits. The cells are connected in series; with the higher voltage and freedom from polarization under a heavy and continued current output the cell is popular. The labor involved in making renewals when the cells become exhausted is somewhat greater than for cells using soda or potassium. The objections to the cell are briefly: 1, liability to freeze; 2, expense of renewals. To anticipate freezing, many designs of cellars or wells have been devised. Those made of iron are generally like Fig. 1. In this design, boiler iron ¼ in. thick is used. The

*Previous articles on pages 137, 242, 287 and 382.

well is circular with the bottom riveted in so as to guarantee a water-tight enclosure. The shelves on which the cells are set, the "frost-breaker" and the top are made of wood. These wells are usually 7 ft. deep and 5 ft. in diameter.

There is also a design of cellar, or "tub," as it is usually termed, made of wood of the same general appearance as the iron well just described. In both designs of cellars, it is necessary to provide frost doors or breakers, A X Fig. 1. Where this is not sufficient protection manure must be piled around and over the top of the well.

There is in service a cellar constructed on lines corresponding closely with Fig. 2; in this design, it will be seen that the opening is only 2 ft. square. I have never heard of a frozen gravity cell in such a well; a number are in service in the west and northwest.

Where, because of quicksand, rock or swamp, it is not expedient to use the cellar, it is advisable to build shelters on the surface. Of this type of shelter the most common is a small frame building with double thickness wall and an air space of 3 in. filled with sawdust; double floor and double ceiling lined in same manner. The roof is generally of shingle. This box has withstood temperatures as low as zero, but where the thermometer drops below that point, artificial heat must be provided. This is usually done by burning a kerosene lamp within the shelters. Several railroads have surface enclosures built of concrete. This has been found to meet the conditions quite well. Fig. 3 shows a circular brick shelter with a concrete roof; this is of recent design and is believed to be one of the best shelters in service.

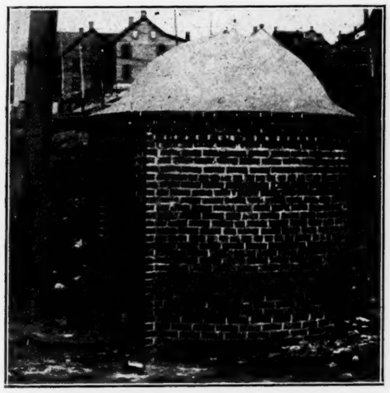


Fig. 3—Brick Battery House.

Cells in surface house shelters are renewed with less labor than cells in cellars or wells, for with the latter all materials must be carried to the bottom or the cells must be carried to the surface of the ground. When gravity battery is used, these interruptions may cause delay to trains, unless they are quickly anticipated, and then only at an increased cost for both labor and material.

Of the second objection, it might be briefly stated that the amount of labor employed to keep in operation 3,000 cells of gravity battery on a certain road originally cost 30 per cent. more than it does at the present time with more improved designs of battery.

The gravity cell is gradually giving way to the more improved types of so-called "acid primary batteries," of which there are two distinct classes; those consisting of a solution of potassium hydrate and those consisting of a solution of sodium hydrate. It is probable that there are in service more cells of the former type than any other except the gravity. The most prominent type of this class is the "Edison Primary Cell." Its general design is too well known to require description. Of the second class there are now four prominent types in the market—Waterbury, Gordon, Nungesser and Gladstone-Lalande. In the first three, the cathode or copper element is in the form of scale instead of a compressed plate as in the Edison. The use of scale makes it necessary to use a perforated basket or cylinder.

In the Gladstone-Lalande, the mechanical construction compares favorably with the Edison Primary, differing from that principally in its solution, which is a 20 per cent. solution of caustic soda. Gravity cells are being replaced by cells of the acid type and frequently they are placed in the enclosures formerly used for the gravity. In many cases it is deemed necessary to keep them underground, so that their solutions can be kept from congealing, which action reduces the e.m.f. Carefully compiled records show a diversity of opinion as to best practice in this direction. During the past winter the potash solution, when used underground, *i. e.*, below the frost line, did not congeal enough to cause a noticeable decrease in e.m.f. This appears to be true of all cells, whether they had recently been renewed or had been in service for a year. These cells had the best protection possible short of applying artificial heat.

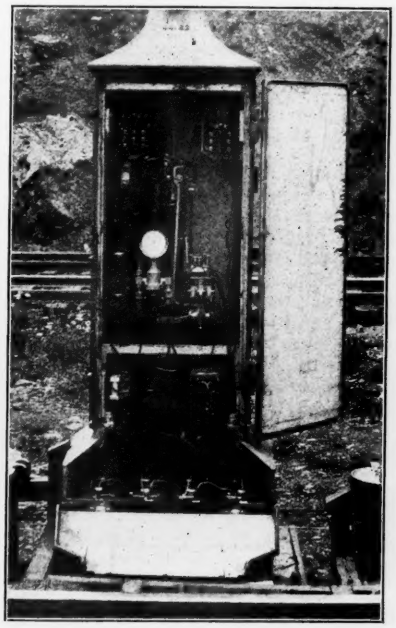


Fig. 4—Iron Battery Enclosure.

There are, however, on record, a large number of failures of this type where the cells were installed within iron enclosures like Fig. 4. The drop in e.m.f. varied in different localities and under different temperatures. In a region where the temperature ranged from 10 deg. F. to 20 deg. F. below zero, many of these cells were frozen into a solid mass and ceased to deliver current; in other localities, the thermometer went as low as 36 deg. F. below zero, but not enough congealing took place to cause the flow of current to cease, although the signals moved slowly; where, under favorable conditions, a signal will move from the stop to the proceed position in 3 to 6 seconds, the time was increased to 30 and even 45 seconds.

As to the cause of this congealing, there is a diversity of opinion. Some claim that it is due to the age of the solution and advocate the renewal of all cells in the fall, so that in cold weather the benefit of the new solution may be had; others think it is the very nature of the solution and that unless heat is applied it cannot be prevented; still another opinion is advanced that the solution is not properly prepared by the men who do the recharging—that they use too much water for the quantity of potash.

A number of cells having a solution of 20 per cent. potassium hydrate with a specific gravity of 1.175 show a decrease of .1 volt per cell in 24 hours with the thermometer at 20 deg. F. below zero. When this drop in voltage was noticed, the specific gravity of the cells was 1.25, they having been in service about six months. As to the renewal of the cells in the fall, opinion differs very much, some claims being made that there is no difference. Cases are cited where renewed cells were placed within the same enclosure with old cells and they all suffered alike. Tests carried through two winters indicate that the trouble is traceable to the density of the solution, principally. It is likely that most of this trouble can be anticipated if the proper strength of solution is used; the trouble with a weak solution being its liability to freeze and with a strong solution to crystallize out.

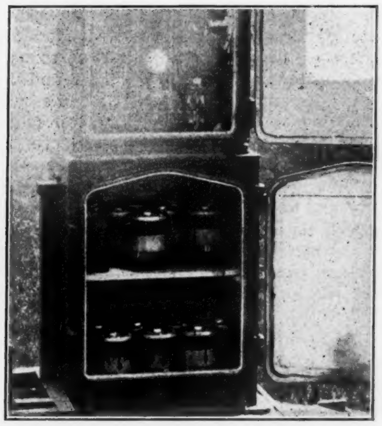


Fig. 6—Iron Battery Enclosure.

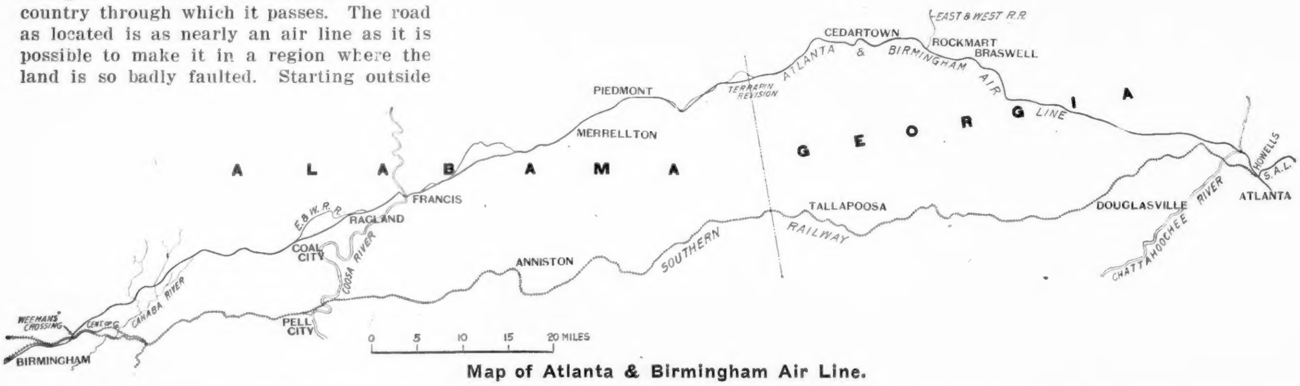
The cells in which a solution of sodium is used have shown remarkable qualities to withstand severe declines in temperature. On a large installation where all of the cells are in enclosures like Fig. 6 and in wooden battery wells like Fig. 5, no case is recorded where there was congealing sufficient to reduce the e.m.f. more than one volt for every 20 cells installed. The temperature ranged from zero to 42 deg. F. below; the specific gravity was 1.25, the cell having been in service about five months. These figures apply to a 25 per cent. solution with a specific gravity of 1.29 when installed.

This record is from sections separated many miles and the solutions had been in service anywhere from a few days to about three years; in one exceptional case the cells had delivered current uninterruptedly for a period of 43 months. This particular battery is still in service and operates a home and a distant enclosed disk signal with an average train movement of 30 trains every 24 hours.

Of the cells using sodium over 100 were in service during the past winter for track batteries in exposed places and no failures occurred. Many were in tunnels and on bridges where the gravity cell could not be kept from freezing even by the use of lamps. But to convey the impression that such cells will not congeal, and even freeze, would be wrong; they are thus affected when too much water is used in the solution.

The Atlanta & Birmingham Air Line.

The Birmingham extension of the Seaboard, or the Atlanta & Birmingham Air Line, as it is commonly known, now building between Atlanta, Ga., and Birmingham, Ala., presents many interesting features owing to the natural characteristics of the country through which it passes. The road as located is as nearly an air line as it is possible to make it in a region where the land is so badly faulted. Starting outside

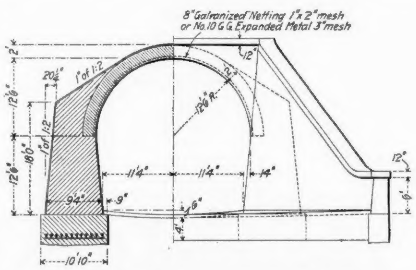


Map of Atlanta & Birmingham Air Line.

of Atlanta at Howells, the line passes in a northwesterly direction through Fulton, Cobb, Paulding and Polk counties, in the State of Georgia, into the Red Mountain district of Alabama, where it runs through the Counties of Calhoun, St. Clair and Jefferson, encountering many coal measures and ridges of limestone. This latter region is noted for its brownstone, iron ore, red hematite, coal and limestone, and these natural features should eventually prove of immense value to the railroad passing through the district. According to the present estimates, the Atlanta & Birmingham Air Line, when completed, will be 166 miles long, the air-line distance between the two cities being about 146 miles.

The Atlanta & Birmingham Air Line is being built under the general specifications of a 1 per cent. grade and a maximum curvature of six degrees, compensated with easements. Seventy-five-lb. rails are used throughout and passing tracks are built every five miles. There will be 16 depots, ten water stations and three coaling stations on the line. The coaling stations will be located at Howells, Rockmart and Coal City and will have a capacity of 800 tons, 250 tons and 200 tons, respectively. They will be equipped with Fairbanks, Morse & Company's gasoline engines and hoisting machinery and the old car-dumping system now in vogue will be abandoned. The water stations will each have a tub capacity of 50,000 gallons. The terminal points on the line will be at Howells, just outside of Atlanta, and at Nineteenth street in Birmingham. At Howells, several new shops and a yard have been built, and at Birmingham a new freight house is now going up.

The work on the main line has been divided into three divisions, the first one extending from Howells to Rockmart, a distance of 45 miles, where connection is made with the old East & West Railroad. This division which is practically a cross country line through a very rugged country, has necessitated a number of heavy cuts and fills and the removal of about 2,750,000 cu. yds. of earth. The heaviest work is at Braswell, thirty-six miles out of Atlanta, where there is a tunnel 700 ft. long, built through solid rock. The rock cut approach at the eastern end of this tunnel is shown in the acccompanying photograph. The work on this division also includes a deck truss bridge with two spans, each 135 ft. long, over the Chattahooche River, four miles out of Atlanta. This bridge has two deck plate girder trestle approaches, the eastern one of which is supported on eight steel bents and the western on four bents. These bents rest on concrete piers and connect the two concrete abutments at either end. Just to the west of this bridge the Atlanta & Birmingham Air Line encounters the Atlanta & West Point Railroad, and a concrete skew arch culvert has been built under the latter road, as shown in the accompanying photograph. This culvert has been made suffi-

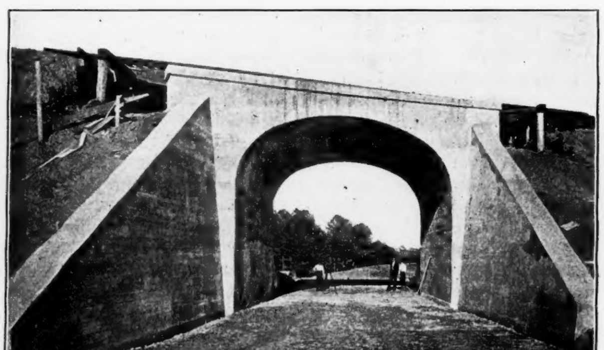


Twenty-five Foot Arch Culvert.

ciently broad for the building of a second track, as it is the intention of the company to eventually make this line double track for the entire distance. Work on this division is well advanced; grading is all completed except on a few short sections and track has been laid for over two-thirds of the distance.

The second division, running from Rockmart, Ga., to Coal City, Ala., is practically a revision of the old East & West Railroad and the work has consisted principally of reducing the alinement from 14-degree

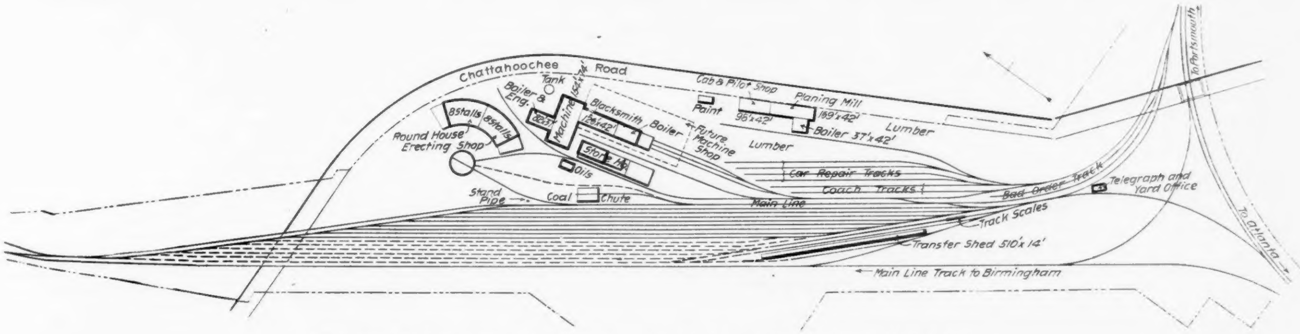
Apprcach to Braswell Tunnel, Looking West.



Skew Arch Culvert West of Chattahoochee River.

curves on the old line to six-degree curves on the new, and the grades, from 2 per cent. to a maximum of 1 per cent., compensated. The distance on the old line between these points is 86 miles, while the new location is only about 80 miles long, saving approximately six miles. The new line generally follows the grade of the East & West roadbed, except between Merrellton and Francis, where an entirely new location has been made. In all cases where the old line is followed, the roadbed has been entirely reballasted and relaid with 75-lb. rails to make it suitable for the heavier class of rolling stock which will pass over it. The work on this division has also included the building of a number of plate-girder bridges in place of the wooden structures in the old line. The largest bridge is over the Coosa River, about 15 miles east of Coal City. This bridge is of plate-girder construction, with three fixed spans and a draw. Smaller bridges have also been erected over Fish Creek, Terrapin Creek and Ohatchee Creek. After passing the Coosa River, the new line diverges sharply from the East & West roadbed at Ragland and passes to the southeast of the old alinement until within a few miles of Coal City. Grading on the second division is completed and track has all been laid.

The heaviest work on the Atlanta & Birmingham Air Line is on the third division, which runs from a point $1\frac{1}{2}$ miles east of Coal City to Birmingham, about 40 miles. It is on this division that the numerous ridges of the Blue Ridge Mountains are encountered, running northeast and southwest, making it impossible in some places to avoid tunneling and necessitating a large number of very heavy cuts and fills. Shortly after leaving Coal City, the line encounters the first ridges in these mountains. As it was found impossible to cut through these ridges, the Hardwick tunnel, which is 1,100 ft. long, was built. This tunnel is already headed and the reinforced timbering is being removed. After leaving the Blue Ridge Mountains, the line passes through the Beaver Valley north of Anderson Mountain and comes to the Black Creek Valley. Three



New Receiving Yard at Howells—Atlanta & Birmingham Air Line.

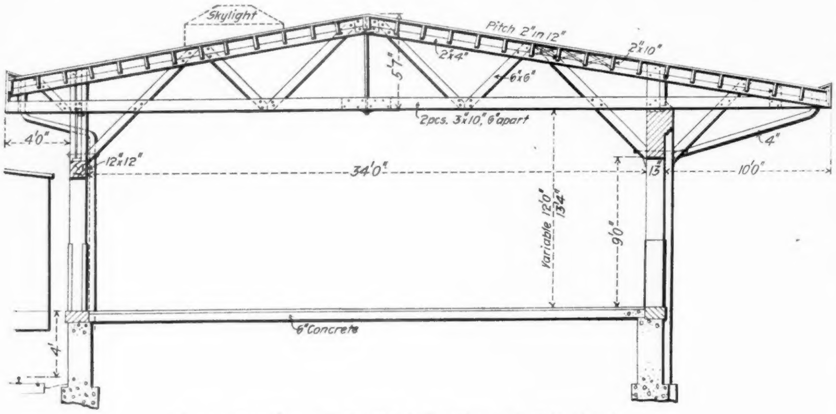
Deck Bridge Over Chattahoochee River—Atlanta & Birmingham Air Line.

creeks run through this valley and over each of these a bridge 75 ft. high has been built. From there on coal measures are again encountered until the Cahaba River is reached. At this point there is a steel viaduct 500 ft. long and 124 ft. high supported on concrete pedestals. The foundations of this bridge are finished and the work on the steel superstructures will soon be begun. After leaving the Cahaba River, the line again encounters a number of ridges and at Roper Gap another tunnel 850 ft. long is being built. The line then runs through a region that is fairly level to a point called Weeman's Crossing, ten miles out of Birmingham. Here the roadbed is elevated, as it crosses over the tracks of the Southern and the Central of Georgia railroads. The terminal point in Birmingham is at Nineteenth street. Grading on this division is now finished and both the tunnels have been headed. Track laying will probably be finished early in the fall.

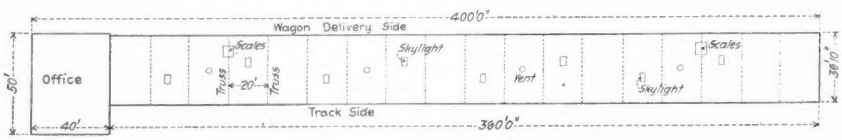
The general features at the terminal consist of a new yard and shop at Howells and a freight station at Birmingham. The buildings at Howells are now all under roof and include a roundhouse and erecting shop, each containing eight stalls. These buildings are built of fireproof construction with walls of brick and concrete. The turntable is 70 ft. in diameter and is 100 ft. from the outside door of the roundhouse. The other buildings in the yard are a boiler and engine shop 37 ft. x 82 ft., machine shop 74 ft. x 154 ft., blacksmith and boiler shop 42 ft. x 252 ft., planing mill 42 ft. x 169 ft., cab and pilot shop 42 ft. x 98 ft. and a storehouse 42 ft. x 154 ft. with a platform 54 ft. x 100 ft. The new receiving yard at Howells has nine receiving tracks and six car repair tracks. The two main-line tracks to Birmingham run just south of the yard, but the arrangement is such that the cars may easily be switched into the receiving yard without disturbing the main-line traffic. The new freight station at Birmingham, on which work is well under way, is located between Nineteenth and Twentieth streets, and will be 360 ft. long on the track side and 400 ft. long on the street side, the extra 40 ft. being devoted to an office building which connects with the end of the freight station. The station is sectioned off by truss spans into 18 divisions, each 20 ft. wide x 34 ft. long. Each of these divisions is provided with a rolling steel door on the track side, which can be pushed to one side when cars are being loaded or unloaded. The top of the rail is 4 ft. below the floor level. Two scales of 5,000 tons capacity each are conveniently located at either end of the building, and light is obtained by means of skylights 4 ft. x 6 ft. cut in the roof at intervals of every 40 ft. The floor is made of 6-in. concrete, with a 3-in. surface mixture of Portland cement and sand, and is supported on 18-in. concrete walls resting on the foundations of the building.

One of the interesting features of the Atlanta and Birmingham Air Line is the number of culverts which have been built along the route. Most of these are of the usual arch design, with heavy abutments. The largest one is on the third division and has a 25-ft. span. This culvert is made of concrete reinforced by corrugated bars. The concrete is 1:3:6 mixture. In order to make the load per square foot on the foundation as nearly uniform as possible, the bottom of the culvert is cut out in the form of a V from each end. The arrangement of the bars at the base of the culvert is clearly shown in the accompanying drawing.

We are indebted to R. H. Jones, engineer in charge of construction; Thomas B. Lee, engineer of the third division, and T. W. Cothram for the data furnished and for the line drawings.



Cross Section of Freight Station at Birmingham.



Plan of Freight Station at Birmingham.

Train Accidents in the United States in May.[1]

eq, 1st, Texas & New Orleans, Dayton, Texas, a freight train was derailed by a broken wheel while passing over a trestle bridge, and 17 loaded cars, most of them oil cars, were derailed and fell to the ravine below. A large part of the bridge was also destroyed.

rc, 2nd, Pennsylvania road, Van Dyke, Pa., rear collision of freight trains, wrecking the engine and 20 cars. The engineman was badly injured.

*unf, 2nd, Great Northern, Shevlin, Minn., passenger train No. 13 was derailed at a bridge which had been weakened by fire, and several cars were damaged. The engine, tender and most of the cars crossed the bridge in safety. The rear car stopped on the bridge and took fire and was burnt up, but the passengers riding in it escaped in safety. Eight passengers were slightly injured.

o, 2nd, Missouri Pacific, Bushong, Kan., the locomotive of a passenger train was wrecked by the explosion of its boiler, and the engineman and fireman were blown out of the engine and badly scalded; but their injuries were not expected to prove fatal.

xc, 4th, 8 p.m., Delaware, Lackawanna & Western, Hoboken, N. J., a westbound passenger train ran over a misplaced switch and into the head of an eastbound passenger train. Both trains were moving slowly. Two passengers and two trainmen were injured.

eq, 4th, St. Louis, Iron Mountain & Southern, Newport, Ark., freight train No. 80 was derailed by a broken journal and nine cars were ditched. Two tramps were killed.

4th, Missouri, Kansas & Texas, Wirth, Ind. T., a freight train was derailed and 11 cars were ditched; one fireman killed. It is said that the derailment occurred at a switch which had been left unfastened.

bc, 5th, International & Great Northern, Phelps, Tex., butting collision between freight train No. 51 and an empty engine, badly damaging both engines. The conductor and fireman of the freight were killed and two other trainmen were injured. It is said that the conductor of the freight overlooked a meeting order.

bc, 5th, 9 p.m., Baltimore & Ohio, Stanley, Ohio, butting collision between a passenger train and a freight, badly damaging both engines and six freight cars. One engineman and six passengers were injured, the engineman fatally.

o, 6th, Pennsylvania road, Ship Road, Pa., the locomotive of a freight train was wrecked by the explosion of its boiler; a brakeman and the fireman were scalded, the brakeman fatally.

unf, 8th, Sonora Railroad, Huachuca, Ariz., a passenger train broke through a bridge which had been weakened by fire, and the engine and all of the cars but one fell 15 feet to the ravine below. The engineman and fireman were fatally injured and one passenger and the express messenger were seriously hurt.

o, 8th, 11 p.m., Denver & Rio Grande, Colorado Springs, Col., one of the two locomotives of passenger train No. 4 was wrecked by the explosion of its boiler, and the engineman and fireman were injured.

xc, 9th, Norfolk & Western, Bristol, Va., a freight train drawn by two engines became uncontrollable on a steep descending grade and ran at high speed to the junction with the Southern Railway, where it collided with an engine on that road. Two engines and several cars were badly damaged. One fireman and two enginemen were injured.

dn, 10th, 1 a.m., New York, New Haven & Hartford, Port Chester, N. Y., a westbound train of Adams Express Company's cars was derailed by running through a crossover at high speed, and the engine was overturned and fell down a bank. The engineman was killed and the fireman fatally injured. The engineman appears to have disregarded a distant and a home signal set against him.

eq, 11th, Illinois Central, Dixon, Ill., a passenger train was derailed by the breaking of a truck of a refrigerator car in the front part of the train, and three cars were badly damaged. Two trainmen and several passengers were injured.

eq, 11th, Southern Railway, Rock Fish, Va., passenger train No. 39 was derailed at or approaching a steel trestle bridge, by the breaking of a side rod of the engine. Two sleeping cars broke through the bridge floor

[1]Accidents in which injuries are few or slight and the money loss is apparently small, will as a rule be omitted from this list. The official accident record published by the Interstate Commerce Commission quarterly is regularly reprinted in the *Railroad Gazette*. The classification of the accidents in the present list is indicated by the use of the following

ABBREVIATIONS.

rc Rear collisions.
bc Butting collisions.
xc Miscellaneous collisions.
dr Derailments; defect of roadway.
eq Derailments; defect of equipment.
dn Derailments; negligence in operating.
unf Derailments; unforeseen obstruction.
unx Derailments; unexplained.
o Miscellaneous accidents.

An asterisk at the beginning of a paragraph indicates a wreck wholly or partly destroyed by fire; a dagger indicates an accident causing the death of one or more passengers.

and fell part way down to the ground below, crushing the members of the bridge as they fell. Two tramps were killed.

unx, 12th, Illinois Central, Middleburg, Tenn., passenger train No. 5 was derailed and the engine was overturned. The engineman was killed and the fireman and two other trainmen were injured.

unf, 12th, Pennsylvania Railroad, Trenton, N. J., a freight train was derailed by sand which had been washed on the track by water overflowing from a canal, and two main tracks were blocked. A second freight train ran into the wreck and 20 cars were badly broken up. A fireman was injured.

unx, 12th, Union Pacific, Carter, Wyo., passenger train No. 2 was derailed and five cars were ditched. Three passengers were injured.

unx, 12th, Atlantic Coast Line, Hope Mills, N. C., a freight train was derailed and the engine and many cars were wrecked. The engineman was killed and the fireman injured.

bc, 13th, 4 a.m., Cincinnati, New Orleans & Texas Pacific, Danville, Ky., butting collision of freight trains, wrecking both engines and several cars. It is said that the northbound train ran past a station at which it had orders to wait for the southbound.

unx, 15th, Chicago, Burlington & Quincy, Plattsmouth, Neb., a freight train was derailed and the engine and four cars were ditched. The fireman, engineman and one brakeman were injured, the fireman fatally.

xc, 16th, Great Northern, Monroe, Wash., a westbound passenger train ran over a misplaced switch and into some freight cars standing on a side track, wrecking the engine and several freight cars. One brakeman was killed and the fireman was fatally injured.

xc, 17th, night, Southern Railway, Proffit, Va., passenger train No. 39 ran over a misplaced switch and collided with a freight car standing on the side track, and the engineman was injured. It is said that the switch had been maliciously misplaced and that the light was fixed so as to indicate all-clear.

†eq, 17th, Chicago, Burlington & Quincy, Moorcraft, Wyo., passenger train No. 42 was derailed by a brake-beam falling to the track, and the engine and three cars fell down a bank. One passenger was killed and three were injured.

bc, 19th, Delaware & Hudson, Lanesboro, Pa., butting collision of freight trains, making a bad wreck; one fireman killed and five other trainmen injured. It is said that contradictory orders had been given by the despatcher.

bc, 19th, St. Louis, Iron Mountain & Southern, Piedmont, Mo., butting collision between a passenger train and a freight; one engineman killed and 10 passengers injured.

xc, 19th, 4 a.m., Erie road, Avon, N. Y., a freight train broke in two and the rear portion afterward ran into the forward one, wrecking several cars. Three trainmen were injured.

19th, Pennsylvania road, Philadelphia, Pa., the rear truck of the rear car (a combination baggage and passenger car) of the Pennsylvania Limited express was derailed at a switch, and the baggageman, the barber, and a porter were injured. The car ran against a support of an overhead bridge and was broken in two; it took fire from a heater in the buffet but the flames were soon extinguished.

unx, 21st, Denver & Rio Grande, Salida, Colo., a passenger train was derailed; engineman killed and 38 passengers injured.

o, 22d, St. Louis Southwestern, Pine Bluff, Ark., a car in a freight train took fire from a heated journal, and, with 13 other cars and a trestle 900 ft. long, was burnt up.

dn, 23d, Atlanta, Knoxville & Northern, Knoxville, Tenn., a train consisting of a switching engine and 30 coal cars descending a steep grade was turned on to a spur track by a misplaced switch and ran off the end of the spur and was wrecked. Twenty of the cars fell down a bank.

unx, 23d, Southern Railway, Harrodsburg, Ky., a passenger train was derailed and one passenger car was overturned. A brakeman was injured. All of the 20 passengers in the overturned car escaped without serious injury.

o, 23d, Philadelphia & Reading, Pottstown, Pa., the locomotive of a passenger train was badly damaged by the explosion of its boiler and the road foreman of engines and the fireman were fatally injured.

eq, 24th, Missouri Pacific, Kansas City, Mo., a freight train was derailed by a brakebeam which fell on the track, and 12 cars were ditched. Of two trespassers who were riding in the ice box of a refrigerator car one was killed and the other was badly injured.

unf, 24th, Pennsylvania road, Manor, Pa., a freight train was derailed at a misplaced switch and the two engines drawing it fell against and knocked down two buildings. The fireman was killed. The switch is said to have been maliciously misplaced.

xc, 25th, Pennsylvania Lines, East Liverpool, Ohio, a passenger train collided with some freight cars which had escaped control on a side track and had run on to the main track, and 15 passengers and three trainmen were injured.

dn, 25th, Vicksburg, Shreveport & Pacific, Haughton, La., a passenger train was derailed by running over a misplaced switch, and the first three cars were wrecked. Two mail clerks were killed and six other persons were injured.

dn, 25th, Atlantic Coast Line, Thomasville, Ga., passenger train No. 23 was derailed at a misplaced switch and the engine was overturned. The engineman was injured.

eq, 26th, Chicago, Burlington & Quincy, Alton, Ill., freight train No. 12 was derailed by the breaking of a truck of an oil tank car while running at high speed on a descending grade, and about 20 cars fell through a bridge over Apple Creek. The conductor fell 50 ft. with his caboose to the stream beneath the bridge, but was not badly injured.

rc, 28th, Pennsylvania road, Lancaster, Pa., the westbound St. Louis express, standing at the station, was run into at the rear by a following express train, damaging the engine and one sleeping car. It is said that the second train had been admitted to the block section by a clear signal given by mistake.

unx, 29th, Chicago, Rock Island & Pacific, Trenton, Mo., freight train No. 95 was derailed and seven loaded cars were ditched. An unknown man was killed.

xc, 30th, Grand Rapids & Indiana, Grand Rapids, Mich., collision between a passenger train and an empty engine, one of the engines being overturned. One engineman was severely scalded.

unx, 30th, St. Louis & San Francisco, Denison, Texas, a passenger train was derailed and several cars were badly damaged; one express messenger and one postal clerk were injured, the former fatally.

Master Mechanics' Reports.

SUBJECTS.

Committee Work.—(1) What can and should be done to reduce locomotive terminals to the basis of a machine for treating and handling engines, apart from the question of housing, the object being prompt handling of power, greater efficiency in service and less detention at terminals, while affording more time and better facilities for care and repair of engines. (2) The best practice in ash-pan construction, with special reference to wide fire-box engines having trailing wheels. To embrace best design of trailing wheel arrangement. (3) Merits of the balanced compound locomotive. (4) Investigation of design and material for locomotive fronts and front doors, with a view to affording relief from leaky front-ends. (5) Investigation of the subject of stay-bolts —committee to consider the material, iron, bronze and copper, as well as the form of the bolt under the conditions and temperatures met in service. (6) Modification in design of wide fire-boxes of locomotives, with a view of limiting injury in case of low water. Committee to consider the question of fusible plugs as to number, location and size, and also the application of water circulating pipes from throat to crown sheet, and other devices which will localize the damage. (7) The practicability of water softening for locomotive use by means of chemicals or the application of heat and the maximum cost per 1,000 gallons permissible. (8) The value of superheated steam for locomotive work. (9) The advisability of a 4-4-2 Atlantic-type locomotive for light passenger service and a 4-6-0 locomotive for fast freight service. (10) Committee appointed to act as an advisory committee to the Pennsylvania with reference to the locomotive testing plant at St. Louis Fair to present to Master Mechanics' Association summarized statement of important results which are obtained. (11) Best method of heating and ventilating roundhouses. (12) Best method of fire protection for railroad shops.

Individual Papers.—(1) The strict observance of the golden rule in management of workshops. (2) The most efficient organization for the mechanical department. (3) The average engine hours locomotives are in service, in shop under repairs, or waiting to get in shop, per annum, and the percentage of total time locomotives are actually in and out of service per annum. (4) Shop layouts for roads having 350, 500, 750 and 1,000 locomotives.

Topical Discussions.—(1) For lubricating main, side-rod and driving-box bearings, which is the better practice, to use grease or oil? (To be opened by T. S. Lloyd.) (2) With the large modern engines equipped with power brakes, is not screw reverse mechanism preferable to present hand lever arrangement, and is quick reversal a vital consideration? (To be opened by James McNaughton.) (3) What is the best practice with reference to providing air spaces under locomotive grates, especially with wide firebox locomotives? (To be opened by F. J. Cole.) (4) What is the best method of caring for exterior of locomotive front ends, from the standpoint of cost and appearance? (To be opened by W. O. Thompson.) (5) Packing for air pumps for high-speed brakes. (To be opened by A. J. Cota.) (6) The advisability of reducing the diameter of stay-bolts and shortening the space between the stay-bolts proportionately. (To be opened by G. R. Henderson.) (7) Leaky flues in wide fire-box engines. (To be opened by M. K. Barnum.) (8) Limit of width of soft-coal-burning fire-boxes, with reference to higher evaporation efficiency. (To be opened by S. M. Vauclain.)

The report is signed by Henry Bartlett, Chairman; J. F. Deems, A. W. Gibbs.

LOCOMOTIVE FRONT-ENDS.

The committee consisting of H. H. Vaughan, G. M. Basford, F. H. Clark, W. F. M. Goss, A. W. Gibbs and R. Quayle reported that further tests cannot be made until funds are provided. An outline of proposed tests is given.

VARIABLE SPEED MOTORS.

(From a paper by C. A. Seley.)

Complete tests of all motors and controllers have been made at the East Moline shops of the Rock Island and certain typical ones are selected for this report. The tests were made by Mr. S. B. Seaman, of the General Electric Company and Mr. C. H. True, assistant superintendent at the shops.

The variable speed motors at these shops may be subdivided into four types:

(1) Variable speed motors having a controller to operate on a three-wire system, enabling the machine-hand to operate the motor on either of the two voltages. Further speed variation is obtained on each voltage by introducing or cutting out resistance coils in series with the motor field. This motor field is always across the outside wires of the three-wire system, and therefore, on the maximum obtainable voltage. The rheostat governing the field current is operated through the controller. (2) Variable-speed motors having a controller to

Test 1—69-inch Driving Wheel Lathe, Turning 62½-inch Tires; Motor, Type CK. 8-15-150/600.

Rheostat.	Field Amps.	Armature. Amps.	Armature. Volts.	Elec. H. P.	Cutting Speed F. P. M.	Remarks.
00	5.55	5	118	1.6	...	Motor running light. Two chips, 3/16x¼ deep x .089 per revolution.
0	4.70	22	104	..	7.5	
3	4.00	23	116	4.6	8.0	
4	3.90	23	116	..	...	
5	3.30	26	116	..	...	
6	3.10	25	116	..	...	
7	2.90	27	116	5.1	...	
9	2.90	25	116	..	...	
10	2.45	26	116	..	...	
11	2.20	30	116	5.3	...	
12	1.95	30	116	..	11.45	
14	1.95	30	115	..	...	
16	1.50	38	113	6.3	12.90	
0	4.60	36	230	12.5	14.60	

Test 2—Speed Variation, Wheel Lathe Without Load.

Rheostat.	Field Amps.	Volts.	R. P. M.	Remarks.
Off	3.00	114	0	....
1	5.55	114	150	....
2	4.80	113	158	....
3	4.15	113	165	....
4	3.75	113	170	....
5	3.25	113	175	....
6	3.00	112	185	....
7	2.75	111	195	....
8	2.50	114	205	....
9	2.30	113	215	....
10	2.15	114	225	....
11	2.00	113	230	....
12	1.90	113	240	....
13	1.80	113	[illegible]	....
14	1.70	113	265	....
15	1.60	114	275	....
16	1.55	114	295	....
1	5.45	227	290	....
16	1.55	227	630	....

Test 3—18-inch Slotter; Motor, Type CK. 8-15-150/600.

Rheostat.	Amperes.	Volts.	El. H. P.	Remarks.
3	1 to 10	115	1.4	Chip 5/16 x 3/64.
8	1 to 24	115	3.7	Chip ⅝ x 3/64.
8	1 to 30	115	4.6	Chip ¾ x 3/64.
12	1 to 28	115	4.3	Chip ½ x 3/64.
16	4 to 10	115	1.4	Chip 1/16 x 3/64.

Slotter was making 22 cycles on the 12th point of rheostat on work about 5 inches deep.

Test 4—72-inch Boring Mill, Boring Steel Tire, 52 Inches Inside Diameter; Motor, Type CK. 0-10-275/1000.

Amps.	Volts.	El. H. P.	Cut F. P. M.	Remarks.
17	115	2.6	17.7	
23	115	3.1	18.5	
26	115	3.5	18.5	
30	115	4.0	19.4	One chip ¼ x 3/64.
33	115	4.4	20.4	
39	115	5.2	22.2	One chip 3/16 x 3/64. Chips of dark blue.

The following readings were taken at intervals of approximately three seconds:

Amps.	Volts.	El. H. P.	Cut F. P. M.	Remarks.
44	115	..	22	
48	115	4.8	22	Two chips, ¼ x 3/32 each. Cutting tools would not stand up under this work. Although there was an excessive ampere overload there was no sparking or heating at any point about the motor.
37	115	..	22	
39	115	..	22	
38	115	..	22	
52	115	..	22	
50	115	..	22	
50	115	..	22	
48	115	..	22	
49	115	..	22	

Test 5—Driving Axle Lathe; Motor, Type CK. 8-15-150/600.

Rheostat.	Field Amps.	Arm. Amps.	Volts.	El. H. P.	Cut F. P. M.	Remarks.
0	5	29	114	5.9	17	Two cuts on 8-inch axle, 3/16 x 5/64.
2	..	31	112	..	..	
3	4	32	111	..	..	
4	3.9	33	112	6.15	..	
5	3.3	35	112	..	..	
6	3.1	36	112	..	18.7	
7	2.9	39	112	6.85	..	
8	2.8	42	112	..	..	
9	2.6	44	112	..	21.9	
10	2.4	47	114	8.0	..	
11	2.2	48	116	..	..	
12	1.9	52	118	8.7	25	

Did not get over on to 230-volt side.

Test 6—36-inch Triple-Geared Lathe; Motor, Type CE. 8-5-400/1600.

Rheostat.	Arm. Amps.	Volts.	El. H. P.	Cut F. P. M.	Remarks.
0	1	117	.5	..	Motor light.
0	10	117	1.5	42	Back gear in with heavy-cut,
0	22	117	3.5	42	cast iron, 11 inches diam.
4	1.5	118	.7	48	Back gear in, light.
4	8	118	1.3	48	Back gear in with heavy cut,
4	23	118	3.7	48	cast iron, 11 inches diam.
4	30	118	4.9	48	
4	40	117	6.3	48	

Test 7—42-inch Steel-Tire Lathe; Motor, Type CE. 6-10-550/1100.

Rheostat.	Field Amps.	Arm. Amps.	Volts.	El. H. P.	Cut in F. P. M.	Remarks.
0	3	7	236	3.1	...	Lathe running light.
0	3	12	229	4.7	9.6	Starting 2 cuts 30-inch wheels, 3/32-inch feed
4	1.9	13	231	4.6	15	2 cuts, 3/32 x 3/32.
5	1.75	23	231	5.5	15.2	2 cuts, 3/16 x 3/32.
6	1.42	30	230	9.7	15.7	2 cuts, 3/16 x 3/32.
8	1	34	230	10.7	16.1	2 cuts, ¼ x 3/32.
10	1	36	229	11.3	17.2	2 cuts, ¼ x 3/32.
12	1	38	230	12	21.8	2 cuts, ¼ x 3/32.

Test 8—Speed Variation, 42-inch Steel-Tire Lathe Without Load.

Rheostat.	Field Amps.	Volts.	Spindle R. P. M.	Remarks.
1	3	230	1.22	....
2	2.55	230	1.33	....
3	2.20	230	1.43	....
4	1.95	230	1.53	....
5	1.75	230	1.62	....
6	1.62	230	1.62	....
7	1.45	230	1.66	....
8	1.35	230	1.71	....
9	1.25	230	1.81	....
10	1.25	230	1.87	....
11	1.15	230	1.93	....
12	1.12	230	2 00	....
13	1.05	230	2.20	....
14	1.00	230	2.40	....
15	.95	230	2.50	....

Test 9—Special Rod Planer; Motor, Type CK. 8-15-275/550.

Rheostat.	Field Amps.	Arm. Amps.	Volts.	El. H. P.	Cut in F. P. M.	Remarks.
0	4.8	5	227	3	..	Planer running light.
0	4.8	20	225	7.5	17	2 cuts, 3/16 x .083.
2	3.1	21	224	7.2	20	Cutting.
2	3.1	6	224	..	..	Returning
3	2.2	25	225	8.2	24	Cutting.
3	2.2	5	225	..	..	Returning.
4	1.8	30	228	9.7	28	Cutting.
4	1.8	6	228	..	..	Returning.
5	1.5	32	226	10.1	32	Cutting.
5	1.5	9	226	..	..	Returning.
6	1.2	36	225	11.2	35	Cutting.
6	1.2	10	225	..	..	Returning.
7	1.1	36	226	11.2	38	Cutting.
7	1.1	11	226	..	..	Returning.
8	1.	36	224	11.1	40	Cutting.
8	1.	12	224	..	..	Returning.
9	.85	44	225	13.5	45	Cutting.
9	.85	16	225	..	..	Returning.

This planer has done work on Babbitt metal at the rate of 70 feet per minute, the motor running cool and sparkless at 1,300 R. P. M., although the maximum rated R. P. M. is but 550.

Test 10—48 by 48 by 6 Planer; Motor, Type CK. 8-15-275/550.

Rheostat.	Field Amps.	Arm. Amps.	Volts.	El. H. P.	Cut in F. P. M.	Remarks.
0	4.8	12	224	5	..	Cutting 7/16 x 1/32 C. I.
0	4.8	14	224	5.7	..	Returning.
6	1.2	12	224	..	18	Cutting.
6	1.2	14	224	..	..	Returning.
10	1	13	224	..	22.5	Cutting.
10	1	14	224	..	..	Returning.
14	.8	18	224	5.7	..	Cutting.
14	..	20	224	6.3	..	Returning.
15	.8	20	224	..	..	Cutting
15	.8	21	224	..	..	Returning.
16	.75	26	224	7.9	..	Cutting.
16	..	28	224	8.5	..	Returning.

In order to show the variation in load on the motor, the following readings were taken on one point of the rheostat:

Rheostat.	Field Amps.	Arm. Amps.	Volts.	El. H. P.	Cut in F. P. M.	Remarks.
0	..	12	224	5	..	Bed returning.
..	..	32	224	9.6	..	Reversing to cut.
..	..	14.5	224	5.7	..	Cutting.
..	..	54	224	15.6	..	Reversing from cut.
..	..	12	224	5	..	Returning.

Test 11—54 by 54 by 34 Frame Planer; Motor, Type CL. 6-20-375/750.

Rheostat.	Field Amps.	Arm. Amps.	Volts.	El. H. P.	Cut in F. P. M.	Remarks.
0	5.6	12	230	5.4	12.8	Planer running light.
0	5.6	18	228	7.2	..	Returning.
4	2.7	12	230	..	16.75	Two cuts ⅜ x 5/32 C. I.
4	..	18	232	..	..	
8	1.6	14	230	..	22.66	
8	..	20	232	..	..	
12	1.1	18	230	..	28	
12	..	24	232	..	..	
16	.82	22	230	7	31.4	
16	..	28	230	8.9	..	

In order to show the variation in load on the motor, the following readings were taken on the 12th point of the rheostat:

Rheostat.	Field Amps.	Arm. Amps.	Volts.	El. H. P.	Cut in F. P. M.	Remarks.
12	1.1	24	230	7.7	28	Cutting.
..	1.1	56	230	17.6	..	At reverse from cut.
..	1.1	22	230	..	..	Returning.
..	1.1	30	230	9.5	..	Reversing to cut.

Test 12—Motor, 15-h.p.; Semi-Enclosed Constant Speed, Shunt Wound, Silent Chain Drive, Short Centers.

Reading.	Amps.	Volts.	El. H. P.	Remarks.
1	5	235	1.6	Motor running light.
2	6	238	1.9	Motor runnig line shaft.
3	11	226	3.3	Motor line and counters of following tools.
4	12	226	3.6	No. 3 B-B milling machine, fluting tap.
5	13	227	3.95	No. 3 LeB milling machine, fluting reamer.
6	18	226	5.4	24 x 24 Planer at reversing point.
7	20	227	6.1	14-inch lathe, boring 1⅜-inch hole.
8	26	228	7.0	10-inch lathe, 1-16 cut.
9	26	229	7.9	14-inch lathe running to capacity.
10	30	229	9.2	21-inch drill press drilling 1-inch hole in steel.
11	37	228	11.3	Tool dresser.
12	38	228	11.6	Power hack saw.
13	44	227	13.4	Two aut. tool grinders.

The above test was made on a motor driving a group of machines in a tool room. These tools were added one at a time after readings had been taken on the power required for the motor alone, motor and line shaft, and also with the countershafting. The final reading is the total power required, but it is not generally the case that all of the tools of a group are running full at one time.

operate on a two wire system. Speed variation is obtained by means of a bank of resistance coils in series with the motor field, and operated through the controller. (3) Variable-speed motors having separated starting boxes with an auxiliary rheostat in the field circuit and operated by a hand wheel. (4) Variable-speed motors having a reversible controller similar to those in use in street-car service and to reverse the direction of motion of the motor when desired.

Type 1 is used on boring mills, slotters, driving wheel and engine lathes. Type 2 is used on car-wheel borer and car and truck-wheel tire-turning lathes. Type 3 is used on planers and cylinder-boring machines. Type 4 is used on bending rolls.

The following tests were made on motors on the various tools mentioned above, each being tabulated, giving the kind of machine, class of work and the electrical horse-power. Tests 1 to 6 were made on motors of type 2. Column 1 shows the position of the rheostat arm. There are for each voltage 16 successive steps, giving 16 different speeds on each voltage. These positions are given by numbers indicating the number of contacts from the O point to where the rheostat arm is set. Column 2 gives the field current and column 3 the armature current. Column 4 gives the armature voltage, which is about 115 volts over the first range of speed, and 230 volts over the second. Column 5 gives the electrical horse-power delivered to the motor. Column 6 gives the cutting speed in feet per minute. In the headings are given the maker's classification and the speed range of the motors. Intermediate speeds between the limits given are obtainable by operation of the controller handle.

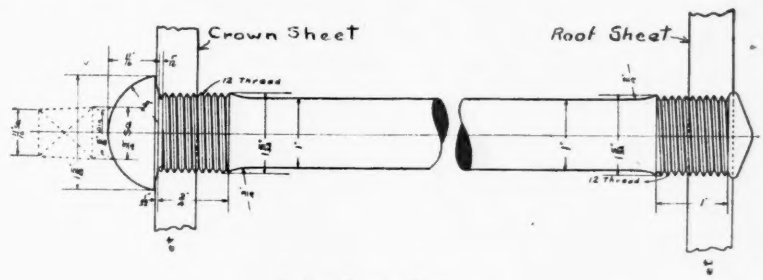
Tests 7 and 8 are of motors of Type 2 and tests 9 to 11 are of motors of type 3. Test 12 is of a group of tools on a motor-driven line shaft.

BOILER DESIGN.

The lowest visible part of the water glass and lowest gage cock should be not less than 3 in. above the highest point of the crown sheet for curved and flat crown sheets, and the water glass and gage cocks should be as near the vertical center line of boiler as possible without having gage cocks out of reach of the engineer. It is also recommended that 8 in. exposed length of water glass and three gage cocks with vertical spacing 3 in. centers is desirable. Crown sheets sloped ¾ in. per foot is general practice and has proved satisfactory. An automatic low-water detector seems not to be a desirable attachment to locomotive boilers. The best form of radial stay shown herewith appears to be general practice and is recommended.

In order to obtain information as to the temperatures inside a boiler as related to leaky flues and burned side sheets, the committee made temperature tests with fusible metal in the water leg, between the flues, and inside of flues plugged up. While the tests show temperatures considerably above saturated steam temperatures in most cases, the committee has concluded that the method of determining temperatures by means of fusible metal is not satisfactory and believes that temperatures should be determined by more delicate means, such as the thermopile, and that such determinations should be as numerous as possible in order to trace the direction of circulation in the boiler. On the other hand it is quite possible that the very high temperatures which are probably required to destroy sheets and cause leaky flues are confined to the sheets themselves, and that little if any higher temperatures exist in the water than have already been found by the fusible metal tests. It is essential that the circulation within the boiler shall follow such lines and proceed with such regularity that solid water may overlie all portions of the heating surface. Since circulation is due to the excess of weight of a comparatively cool column of water over a hotter and lighter body or a mixture of hotter water and steam, the design of boiler which least impedes the flow due to this head will permit of the most rapid circulation, and hence, most rapid carrying away of heat from sheets. It would follow also that the greater the depth of boiler the greater the head to produce circulation at the point where most needed, namely, just above the fire line. For a given boiler there is a maximum allowable steam generation without injury to the sheets, determined by a maximum possible circulation.

Through the courtesy of Mr. F. H. Clark, Superintendent of Motive Power, Chicago, Burlington & Quincy, the committee is permitted to present results of experiments made to determine the temperature of the water in various portions of the boiler when the locomotive is standing, no steam being used from the boiler excepting as required to supply the injector. The results of these experiments indicate that when the feed is delivered in the usual manner to the boiler, the water in the water-leg on the opposite side may have a temperature 100 degrees less than the normal temperature of the boiler, and that the intermixing is greatly improved by using a perforated pipe extending beyond the check within the boiler either longitudinally or transversely, and also, by the omission of a pipe, but by means of an orifice which opens upward. In the progress of the tests it was found, also, that when the intermixing was most complete, the drop in steam pressure was greatest, so that it may almost be said that the degree of intermixing in any given boiler may be judged by noting the rapidity with which the steam pressure falls under the action of the injectors when the locomotive is at rest. It is recommended that laboratory tests be made for the purpose of determining the rapidity of circulation in a boiler generating varying amounts of steam up to its maximum, and also for determining temperatures in the sheets where the greatest trouble is experienced.



Boiler Crown-Stay.

The report is signed by David Van Alstyne, Chairman; W. F. M. Goss, C. E. Fuller, H. T. Bentley, O. H. Reynolds.

AUTOMATIC STOKERS.

The only comparative test that the committee has been able to make shows that there is a saving of not less than 7 per cent. when using the stoker, as compared to the work done by a first-class fireman. This, of course, would indicate a considerably greater saving as compared with ordinary locomotive firemen. In the case mentioned, the engine equipped with the stoker was in service over its run 6 hrs. and 30 mins., while the engine that it was compared with was only 4 hrs. and 7 mins. going over the division. The saving in coal is no doubt largely due to the fact that the coal is evenly distributed, and the furnace door remains closed all the time. When using the stoker the smoke is very much lighter in color, indicating a more thorough consumption of the gases. The darkest color, when the stoker is used, is not more than brown.

When the stoker is used the fireman has to raise the coal from the level of the coal bin of the tender into the hopper of the stoker, a distance of about 30 ins. This is a higher lift than when firing directly into the furnace, but it must be remembered that when the stoker is used the fireman is not required to throw the coal. With the coal conveyor in service the labor of raising the coal into the hopper will be entirely dispensed with and the work of the fireman becomes simply that of an expert in charge of an efficient machine. With the stoker in use very much less trouble with leaky flues will be found on account of maintaining a more even heat in the fire-box. The sheets of the fire-box will last longer for the same reason. It has been proven that corrugation in fire-boxes is due largely to changes in the temperature. When using the stoker the steam pressure may be kept absolutely constant. This is due to the regularity and evenness with which the coal is placed on the grates.

On the ordinary American type of engine there is no necessity for the stoker, as the work is such that an ordinary man can do it with ease, but with the long fire-box type of engine on a long run over a division comparatively free from grades, where the engine is loaded to its maximum capacity all of the time, is where the stoker will be found the most valuable. The present type of stoker will throw about 3,000 lbs. of coal per hour. A modern type of passenger engine with 46 sq. ft. of grate surface and burning 200 lbs. of coal per sq. ft. of grate per hr. will require about 9,200 lbs. of coal per hr. The stoker, as it is built at present, will not serve such a fire-box, but there is no reason why the speed can not be increased and the size of the trough be increased so that a larger amount of coal will reach the fire-box each stroke.

The report is signed by J. F. Walsh, Chairman, and J. G. Neffer.

COST OF LOCOMOTIVE REPAIR SHOPS.

In selecting units on which to base cost figures the square foot and the cubic foot have generally been used for buildings; in power plants the engine horse-power, boiler horse-power and generator kilowatts have also been used; in roundhouses the stall has been taken as the proper unit. In computing the square feet of buildings, the outside dimensions have been used (giving the ground area covered); in computing the cubic feet of buildings, the average external height has been taken (giving the total volume occupied).

In the figures which follow, the differ-

ent items are identified by reference numbers only, with such explanatory notes added as will aid in interpreting the unit prices; shops built prior to 1895 are designated as "old," those built since 1895, as "modern"; in a few cases the notes are based on uncertain information and are followed by an interrogation mark (?).

It is believed that in most cases the cost of a proposed shop will be asked for as soon as the layout plan has been completed, and that the following is the best basis for making an estimate: List up all the buildings, with their ground area in square feet, all the miscellaneous structures, either on the square foot, the lineal foot, or the unit basis (as may appear best), all the track on the lineal foot basis, the turnouts on the unit basis, etc.; assign a unit price to each item, as determined by the special local conditions, carry out the cost extensions, and totalize; to the total thus obtained add a percentage to cover incidentals and items not shown by the layout plan; this percentage may vary from a minimum of 10 per cent. to a maximum of 25 per cent., according to the completeness of the layout plan

Power Plants—Total Cost.

Item.	Cost per Engine H. P.	Cost per Generator K. W.	Cost per Sq. Ft.	Cost per Cu. Ft.	Notes.
131	131.33	219.00	11.40	.40	Far West, modern; a substantial, effective plant devoid of ornamentation or refinements; coal dumped from trestle and shoveled, ashes shoveled.
132	140.27	210.00	7.00	.18	Middle West, modern; building has considerable ornamentation inside and out, but the equipment auxiliaries are simple, overhead crane in engine room.
133	115.00	167.00	12.20	.28	East, modern; building has considerable ornamentation alternating current apparatus inside and out; principally with auxiliary direct current equipment.
134	185.06	278.00	11.50	.36	Middle West, modern; includes (besides boilers, engine generators and air compressors), induced draft apparatus, coal and ash handling apparatus, hydraulic plant, etc.
135	129.28	210.60	14.62	.33	Middle West, modern; a very complete plant both mechanically and architectually.
136	123.00	191.00	14.30	.36	Middle West, modern; large enough to allow for a one-third increase in capacity of plant.
137	129.00	225.00	10.40	.58	East, modern; fireproof construction throughout.
138	90.90	151.50	10.40	.24	West, modern; a simple but effective plant limited to direct current, no coal or ash handling apparatus.
139	128.60	211.00	10.55	.31	Middle West, modern; condensing equipment.

Erecting and Machine Shops.

	Cost per Sq. Ft. of Ground Area.				Cost per Cu. Ft.	
Item.	Building Only.	Tools.	Misc. Eqpt.	Total.	Building Only.	Total
140	3.50	1.08	.71	5.34	.076	.115
141	1.03	2.49	.187	3.70	.034	.123
142	.706	1.78	..	...	.029	...
143	1.67	2.05	.086	3.79	.051	.118
144	2.43	.81	...	...	.051	...
145	1.65	2.69	...	...	.041	...
146	1.80	1.65	...	...	.046	...
147	1.82	...	...	...	.050	...
148	3.08	1.63	...	...	.073	...

140. *East, modern; brick and steel transverse shop, erecting shop has both heavy and light cranes; machine shop has crane service throughout, saw tooth roof.*

141. *Middle West, old; brick and wood, transverse shop in two parts, one part one story with slate roof, the other part two stories with gravel roof.*

142. *Middle West, old; stone and wood, transverse shop, gravel roof supported by posts.*

143. *Middle West, old; brick with wood and iron roof trussing and shingle roof, longitudinal shop, machine shop on one side, traveling cranes in erecting shop.*

144. *Middle West, modern; brick and steel, transverse shop, high for two-thirds of width with heavy crane, the remaining one-third being low, with saw-tooth roof.*

145. *Middle West, three-fourths old, one-fourth new, brick and steel, transverse shop, new part two stories; no traveling cranes.*

146. *Pacific Northwest, modern; brick and steel, overhead crane.*

147. *Pacific Southwest, modern; brick and steel, overhead crane.*

148. *Far West, modern; brick and steel, overhead crane.*

Machine Shop.

	Cost per Sq. Ft. of Ground Area.				Cost per Cu. Ft.	
Item.	Building Only.	Tools.	Misc. Eqpt.	Total.	Building Only.	Total.
157	.952	...	..	...	.038	...

157. *Middle West, old; brick and wood, gravel roof supported by posts.*

Boiler and Tank Shops.

	Cost per Sq. Ft. of Ground Area.				Cost per Cu. Ft.	
Item.	Building Only.	Tools.	Misc. Eqpt.	Total.	Building Only.	Total.
158	2.98	.72	.84	4.54	.083	.127
159	1.58	.40	..	...	.049	...
160	.84	.94	.076	1.87	.033	.075
161	1.66	.48	.083	2.24	.059	0.80
162	.99	..	..	...	.025	...
163	1.53	.96	..	...	.095	...

158. *East, modern; brick and steel, cranes cover entire floor, saw tooth roof.*

159. *Middle West, modern; brick and steel, one-half width high for crane service, the other half lower and without crane.*

160. *Middle West, old; brick and wood with slate roof.*

161. *Middle West, old; brick and wood, shingle roof, gallery along one side, cranes over part of floor space.*

162. *Pacific Southwest, modern; brick and steel, overhead crane, smith shop in one end.*

163. *Middle West, two-thirds old, one-third new; brick and wood, new part two stories, no overhead cranes (?)*

Smith Shops.

	Cost per Sq. Ft. of Ground Area.				Cost per Cu. Ft.	
Item.	Building Only.	Tools.	Misc. Eqpt.	Total.	Building Only.	Total.
164	...	.734	.110	...	...	...
165	2.63	.982	.171	3.78	.080	.115
166	1.79	.144	..	..	.049	..
167	.432	2.26	.086	2.77	.019	.126
168	1.06	1.09	.050	2.22	.035	.074
169	2.25	...	..	..	..	..
170	1.43	.665	.435	...	.042	...
171	1.50	...	..	...	...	...
172	2.37	1.96	.348	4.68	.052	.104
173	1.21	...	..	...	.041	.055
174	1.38	...	..	...	...	...
175	.91	.60	..	...	.031	...

164. *Middle West, old.*

165. *East, modern; brick and steel, high and light, thoroughly equipped.*

166. *Middle West, modern; brick and steel, one hundred feet wide, hip roof without posts.*

167. *Middle West, old; brick and wood with slate roof.*

168. *Middle West, old; brick and wood, shingle roof.*

169. *Southeast, modern; brick and steel, unusually high (thirty-three feet from floor to lower chord of roof truss). (These figures should be used with caution, as they are not official, but were taken from a published statement.)*

170. *Middle West, modern; brick and steel.*

171. *Middle West, modern; brick and steel, tile and gravel roof.*

172. *Middle West, modern; brick and steel, brass foundry and car machine shop under same roof, equipment very complete.*

173. *East, modern; concrete and steel, 80-foot span, no posts.*

174. *Northeast, modern; brick and wood, 60-foot span, no posts, simple construction.*

175. *Middle West, two-thirds old; one-third new; brick and wood. (?).*

Iron Foundry.

	Cost per Sq. Ft. of Ground Area.				Cost per Cu. Ft	
Item.	Building Only.	Tools.	Misc. Eqpt.	Total.	Building Only.	Total.
176	3.18	...	..	...	...	...

176. *Brick and steel, modern; U. S. Navy Yard, Bremerton, Wash.*

Pattern and Upholstery Shop.

	Cost per Sq. Ft. of Ground Area.				Cost per Cu. Ft.	
Item.	Building Only.	Tools.	Misc. Eqpt.	Total.	Building Only.	Total.
178	.857	...	.131	.988	.043	.050

178. *Middle West, old; modern building, two stories.*

Passenger Car Repair Shops.

	Cost per Sq. Ft. of Ground Area.				Cost per Cu. Ft.	
Item.	Building Only.	Tools.	Misc. Eqpt.	Total.	Building Only.	Total.
179	1.24	...	.016	1.25	.042	.043
180	1.20	...	...	...	...	...
181	2.64	.044	.096	2.78	.099	.105
182	1.34	...	.015	1.35	.056	.057
183	.68	.003	.057	.74	.026	.028
184	.83	...	..	...	.029	...

179. *Middle West, modern; longitudinal shop, brick and wood.*

180. *Southeast, modern; transverse shop, brick and wood, has upholstery and cabinet shops under same roof. (These figures should be used with caution, as they are not official, but were taken from a published statement.)*

181. *Middle West, modern; transverse shop, brick and steel, includes upholstery and trimming shop and hot-air heating.*

182. *East, modern; transverse shop, brick and steel with cement foundations, saw tooth wooden roof.*

183. *Southeast, modern; transverse shop, brick up to window sills, corrugated galvanized iron sheathing on wooden frame above, gravel roof, granolithic floor, used also for painting and varnishing. (Identical with Passenger Car Paint Shop No. 193.)*

184. *Middle West, old; brick and wood (?).*

Passenger Car Paint Shops.

	Cost per Sq. Ft. of Ground Area.				Cost per Cu. Ft.	
Item.	Building Only.	Tools.	Misc. Eqpt.	Total.	Building Only.	Total.
185	1.24	...	.044	1.24	.04	.04
186	1.94	.055	.092	2.09	.072	.078
187	1.02	...	..	...	.033	...
188	1.20	...	..	...	...	...
189	1.01	...	.039	1.05	.035	.036
190	.35	...	..	...	...	...
191	2.36	.009	.056	2.43	.081	.084
192	1.13	...	.009	1.14	.051	.052
193	.68	.003	.057	.74	.026	.028
194	.89	...	..	...	.032	...

185. *Middle West, modern; longitudinal shop, brick and wood.*

186. *East, modern; longitudinal shop, brick and steel, saw tooth roof, hot-air heating.*

187. *Pacific Southwest, modern; transverse shop, brick and steel.*

188. *Southeast, modern; transverse shop, brick and wood, has varnish room and pipe shop under same roof. (These figures should be used with caution, as they are not official, but were taken from a published statement.)*

189. *Northeast, modern; longitudinal shop, brick and steel, includes small paint, varnish and boiler rooms at one end.*

190. *South, old; wooden structure.*

191. *Middle West, modern; transverse shop, brick and steel, includes cleaning room, varnish room and hot-air heating.*

192. *East, modern; transverse shop, brick and steel with cement foundations, saw tooth wooden roof.*

193. *Southeast, modern; transverse shop, brick up to window sills, corrugated galvanized iron sheathing on wooden frame above; gravel roof, granolithic floor, used also for coach repairs. (Identical with passenger car repair shop No. 183.)*

194. *Middle West, old; brick and wood (?)*

Freight Car Repair Shops.

	Cost per Sq. Ft. of Ground Area.				Cost per Cu. Ft.	
Item.	Building Only.	Tools.	Misc. Eqpt.	Total.	Building Only.	Total.
195	.40	...	.016	.415	.022	.023
196	2.12	.123	.047	2.29	.075	.080
197	.29	...	...	.29	.015	.015

195. *Middle West, old; wooden building, longitudinal, entirely enclosed.*
196. *Middle West, modern; brick and steel, longitudinal, includes cabinet shop and hot-air heating.*
197. *Middle West, old; large shop, longitudinal construction not known, but probably wood with partly open sides.*

Car Smith and Car Machine Shop.

	Cost per Sq. Ft. of Ground Area.				Cost per Cu. Ft.	
Item.	Building Only.	Tools.	Misc. Eqpt.	Total.	Building Only.	Total.
199	.77	1.06	..	...	.028	...

199. *Middle West, old; brick and wood.* (?)

Wheel and Axle Shop.

	Cost per Sq. Ft. of Ground Area.				Cost per Cu. Ft.	
Item.	Building Only.	Tools.	Misc. Eqpt.	Total.	Building Only.	Total.
200	4.03	2.16	.72	6.91	.16	.276

200. *West, modern; brick and steel, for car work only.*

Car Repair Shop and Planing Mill.

	Cost per Sq. Ft. of Ground Area.				Cost per Cu. Ft.	
Item.	Building Only.	Tools.	Misc. Eqpt.	Total.	Building Only.	Total.
201	.975	...	..	...	.031	...

201. *Pacific Southwest, modern; brick and steel, has intermediate two-story section for sub-departments.*

Planing Mills.

	Cost per Sq. Ft. of Ground Area.				Cost per Cu. Ft.	
Item.	Building Only.	Tools.	Misc. Eqpt.	Total.	Building Only.	Total.
202	.487	.54	.010	1.04	.026	.056
203	1.15	1.18	.25	2.58	.045	.102
204	.76	1.21	.292	2.26	.033	.098
205	1.85	...	..	...	...	...
206	.37	...	..	...	...	...
207	2.54	1.44	.082	4.06	.095	.153
208	2.53	.558	..	...	.057	...
209	.39	.50	..	...	.014	...
210	.74	.485	.239	1.47	.037	.073

202. *Middle West, old; wooden building, tools and equipment very light.*
203. *Southeast, modern; brick up to floor line, then corrugated galvanized iron on insulated wooden frame, basement and one story, gravel roof, mechanical power plant in annex, cabinet shop in wing.*
204. *Middle West, old; brick and wood, slate roof.*
205. *Southeast, modern; steel and brick. (These figures should be used with caution, as they are not official, but were taken from a published statement.)*
206. *South, old; wooden structure.*
207. *Middle West, modern; brick and steel, does not include cabinet shop, which is separate.*
208 *Middle West, old; brick and wood, includes pattern shop.* (?)
210. *West, modern; wooden.* (?)

Storehouses.

	Cost per Sq. Ft. of Ground Area.				Cost per Cu. Ft.	
Item.	Building Only.	Tools.	Misc. Eqpt.	Total.	Building Only.	Total.
211	1.142	...	.168	1.31	.044	.050
212	3.60	...	..	...	...	...
213	3.05	...	.67	3.72	.073	.089
214	2.40	...	..	2.72	.110	.124
215	2.00	...	..	...	.050	...

211. *Southeast, modern, brick up to window sills, then corrugated galvanized iron on unsheathed wooden frame, two stories, gravel roof, platform, bins, shelves, etc., complete.*
212. *Southeast, modern; brick and steel, two stories and basement, extensive offices in one end on both floorss. (These figures should be used with caution, as they are not official, but were taken from a published statement.)*
213. *Middle West, modern; brick and wood, three stories.*
214. *East, modern; concrete construction, one end two stories, upper floor used for offices.*
215. *Middle West, old; brick and wood, two stories.* (?)

Oil Houses.

	Cost per Sq. Ft. of Ground Area.				Cost per Cu. Ft.	
Item.	Building Only.	Tools.	Misc. Eqpt.	Total.	Building Only.	Total.
216	5.41	...	1.43	6.84	.208	.263
217	3.52	...	1.55	5.07	.196	.302
218	1.33	...	...	...	.089	...
219	2.15	...	1.34	3.49	.097	.159

216. *Middle West, modern; brick and steel, basement and one story, full equipment of tanks, etc.*
217. *East, modern; concrete walls and roof, one story with deep basement.*
219. *West, modern; brick and steel, tile roof, two stories.*

Roundhouses.

		Cost Per Stall.			
Item.	Number of Stalls.	Building Only.	Tools.	Misc. Eqpt.	Total.
220	18	1,388.88	......	......	......
221	46	1,155.00	......	......	......
222	10	2,400.00	......	......	......
223	10	1,757.70	......	......	2,090.00
224	30	......	......	......	1,500.00
225	13	1,040.00	......	......	......
226	8	2,750.00	......	......	......
227	7	1,033.00	......	......	......
228	33	......	......	......	2,200.00
229	..	......	......	......	1,845.00
230	44	1,998.00	133.00	328.00	2,459.00
231	30	4,150.00	......	......	......
232	25	1,950.00	......	......	2,455.00
233	48	2,480.00	......	......	......
234	25	1,719.00	......	......	......
235	18	1,011.00	......	......	......
236	23	1,065.00	......	......	......
237	44	1,740.00	......	......	......
238	40	1,875.00	87.50	787.50	2,750.00

220. *Middle West, old; 63-ft. span, brick and wood, slate roof, trussed (no posts.)*
221. *Pacific Southwest, modern;; 80-ft. span, brick and wood, roof supported by posts.*
222. *Far West, modern; part 75-ft. span, part 85-ft. span, brick and wood, gravel roof, supported by posts:*
223. *Far West, modern; 85-ft. span, brick and wood, gravel roof, supported by posts.*
224. *Middle West, old; 65-ft. span, brick and wood, gravel roof, supported by posts.*
225. *Middle West, old; 78-ft. span, brick and wood, gravel roof, supported by posts.*
226. *Middle West, modern; 89-ft. span, brick and wood, gravel roof, supported by posts.*
227. *Middle West, old; 80-ft. span, brick and wood, gravel roof, supported by posts.*
228. *East, modern; 81-ft. span, brick and steel, gravel roof, supported by flat truss (no posts), rolling steel doors, cost does not include heating equipment.*
229. *Northwest, modern; 84-ft. span, brick and wood, gravel roof, supported by posts, cost does not include heating equipment.*
230. *Northeast, modern; 80-ft. span, brick and wood, gravel roof, supported by posts, annex with boilers, heating apparatus (hot air), and air compressor.*
231. *East, modern; 90-foot span, brick and steel, slag roof, with crane runway covering outer half of span, has very heavy pile and stone foundation.*
232. *East, modern; 80-ft. span, concrete and wood, gravel roof, supported by posts.*
233. *Northeast, modern; 75-ft. span, brick and wood, gravel roof, supported by posts.*
234. *Northeast, modern; 75-ft. span, brick and wood, gravel roof, supported by posts.*
235. *Northeast, modern; 72-ft. span, brick and wood, gravel roof, supported by posts.*
236. *West, modern; 80-ft. span, brick and wood, gravel roof, supported by posts.*
237. *Middle West, part old, part modern; 70-ft. and 85-ft. spans, gravel roof, supported by posts.* (?)

Lavatory.

	Cost per Sq. Ft. of Ground Area.				Cost per Cu. Ft.	
Item.	Building Only.	Tools.	Misc. Eqpt.	Total.	Building Only.	Total.
239	...	...	..	2.55	...	...

239. *Middle West, modern; average of three large lavatories (including water closets, urinals, wash room and locker rooms); buildings of concrete and brick with tile roofs on wooden trusses; cement floors, complete with contents, ready to use.*

Office Buildings.

	Cost per Sq. Ft. of Ground Area.				Cost per Cu. Ft.	
Item.	Building Only.	Tools.	Misc. Eqpt.	Total.	Building Only.	Total.
240	.306	...	...	...	.030	...
241	8.01	.557	.295	8.86	.167	.187
242	1.04	...	...	...	.034	...

240. *Middle West, old; frame building with brick foundation, includes M. M. store department, steam heat.*
241. *Middle West, modern; brick and wood, basement, two stories and attic, ornamental architecture.*
242. *Middle West, old; wooden, two stories and basement.* (?)

Track.

Item.	Cost per Lin. Ft.	Add. For Each Switch.	NOTES.
243	0.70	170.00	Based on use of "fit" (second hand), 67 lb. rail
244	1.00	180.00	Based on use of "fit" (second-hand), 85 lb. rail
245	1.00 to 1.25	75.00 to 125.00	Based on use of new rail, according to weight.

Turntables.

Item.	Diameter.	Cost.	Notes.
246	70 ft.	$3,000	Exclusive of pit.
247	70 ft.	5,091	Including pit. (?)

Transfer Pits and Tables.

	Cost per Sq. Ft. of Pit.			
Item.	Pit.	Table.	Total.	Notes.
248	.31	.17	.48	Far West, modern; to handle the heaviest class of engines
249	.43	.16	.59	East, modern; pit of concrete throughout; capacity of table, 200 tons.

Miscellaneous Structures.

Item.	Name.	Cost.	Notes.	
250	Ash pit........	$30.20 per lineal foot.		
251	Coal chute.....	.65 per sq. foot.	Two sided with trestle approach. (?)	
252	Water tank.....	1,900.00 total	50,000 gal. capacity on timber trestle. (?)	
253	Water pipe, underground laid.	1.43 per lineal foot.	Large system, pipes from 12 in. down to 4 inch.	
254	Sewer pipe, underground laid.	2.88 per lineal foot.	Large system, pipes from 24 in. down to 12 inch.	
255	Long lines of wrought iron pipe (for air, gas or water), with usual proportion of valves, fittings, etc., in place.	25.00 per 100 lineal feet.	1 in. diam.	Given by a large pipe contracting firm of Pittsburg.
		45.00 per 100 lineal feet.	2 in. diam.	
		85.00 per 100 lineal feet.	3 in. diam.	
		130.00 per 100 lineal feet.	4 in. diam.	

Minor Buildings.

Item.	Name.	Cost per Sq. Ft.	Cost per Cu. Ft.	Notes.
256	Iron storehouse..	.24	.011	Old, wooden. (?)
257	Brass foundry....	1.96	.098	Old, brick and wood. (?)
258	Upholstery shop..	.58	.029	Old, brick and wood. (?)
259	Paint mixing shop	.58	.029	Old, brick and wood. (?)
260	Paint storehouse..	1.75	.087	Old, brick and wood. (?)
261	Frght. repair shed	.11	...	New, wooden, open sides. (?)
262	Dry kiln.........	.79	.039	Old, wooden. (?)
263	Lumber shed.....	.21	...	Old, wooden, open sides. (?)
264	Storehouse shed..	.31	.015	Old, wooden. (?)
265	Coal shed........	.24	.020	Old, wooden. (?)
266	Coal shed........	.25	.021	Old, wooden. (?)
267	Charcoal shed....	.21	.017	Old, wooden. (?)
268	Ice house.......	.57	.028	Old, wooden. (?)
269	Ice house	.60	.030	Old, wooden. (?)
270	Crematory	2.52	.210	
271	Small office building	.50	...	Old, wooden, one story.

and the degree of confidence which may be felt in the unit prices assumed; the grand total should represent the approximate cost of the plant, exclusive of the cost of land and grading, which should be estimated separately, these two items not being susceptible of reduction to a unit basis. If the buildings have been designed in detail their cost may be checked upon the cubic foot basis.

The report is signed by R. H. Soule, Chairman; L. R. Pomeroy, T. H. Curtis, S. F. Prince, Jr., A. E. Manchester.

PISTON VALVES.

On the Norfolk & Western Railway the method adopted for testing piston valves was to prepare a packing ring for each end of the valve chamber which could be brought up against the end of the valve, making it absolutely tight. This arrangement is shown in Fig. 1. The valve was then put on the central position on both sides of the engine and disconnected, and, being central admission valves, the steam could be readily admitted to the central portion, and whatever escaped passed down through each end of the cylinder. Pipes were connected up with the cylinder cock openings and the pipes passed through barrels of water, which condensed all of the escaping steam. In most cases gages of mercury columns were placed on the cylinders and readings taken during the test. Three positions were taken of the valve: First, both valves on center; second, with the right valve ⅝ in. forward and left valve ⅝ in. back, and third, the right valve ⅝ in. back and the left ⅝ in. forward. In the positions ⅝ in. out of center, two of the rings are against the steam at one end. The results, however, do not seem to be affected by this.

The tests made for leakage of piston valves on the Lake Shore & Michigan Southern were conducted in the following manner:

The valve (Fig. 2) on one side of the engine was disconnected and set on center, and the reverse lever set so that the other valve, the one to be tsted, was on center. A movement of the valves of about 1 in. was given during the test, by moving the reverse lever. The exhaust pipes were plugged so that no steam could pass to the other cylinder or out of the stack. Hose connections were screwed in the cylinder cock openings and steam condensed in barrels of ice water. The valve was well oiled and the lubricator kept running during the test.

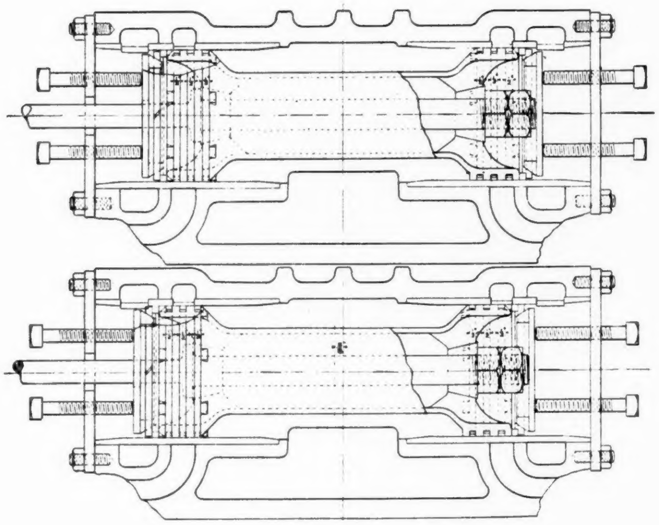


Fig. 1.

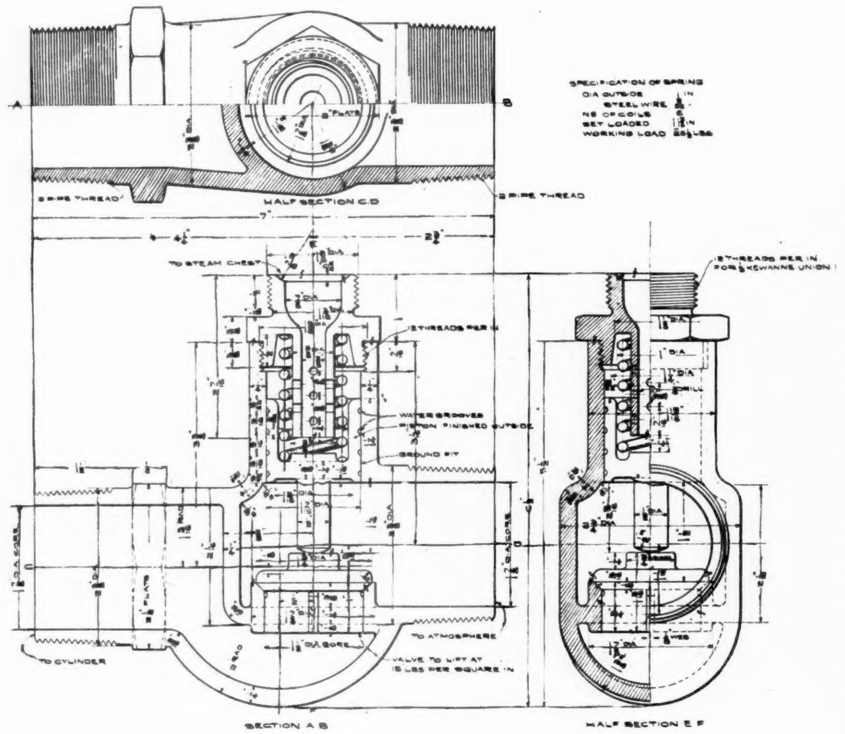


Fig. 3.

Tests for leakage of side valves were made in the following manner on the Norfolk & Western: The valve tested had rectangular balance strips. The exhaust cavity was blocked and leakage was obtained around the balance strips, as well as the face of the valves.

On the Norfolk & Western, a piston valve in good condition loses from 250 to 400 lbs. of steam per hr. The worst valve tested on this road showed a loss of 544.31 lbs. per hr., with a mileage of 13,000 miles. The best slide valve on the Lake Shore & Michigan Southern showed a leakage of 348 lbs. per hr. This valve was in good condition, and had made a mileage of 17,500 miles.

The conclusions derived from these tests do not seem to favor either type of valve. The best piston valve shows a leakage of 268.56 lbs. per hr., and the best slide valve 348 lbs. per hr. If both kinds of valves were given equal attention the piston valve would

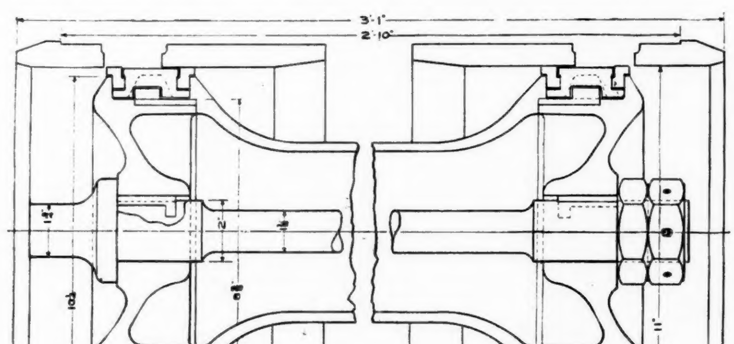


Fig. 2.

be the better as regards leakage around the packing rings.

The need of some kind of relief for the water of condensation in the cylinders or caused by foaming in the boiler, was recognized from the beginning of the application of piston valves to locomotives. The old time slide or "D" valves were perfectly free to lift from the seat and thus relieve the cylinders of water or undue compression; in this respect the valves were automatic. When the balance valve was introduced the lift of the valve became limited by the proximity of the balance plate; however, the reduction of pressure upon the top of the valve allowed an earlier relief than with the unbalanced valve, and the decreased lift was compensated by an earlier opening. Piston valves operating in cylindrical bushings, scarcely larger than the valve itself, can not lift, and if no provision was made, any excess of water in the cylinders would probably damage the cylinder, its head or the piston. This is particularly likely to happen with foaming waters. In the western portion of the United States waters containing large quantities of alkali (soda salts) in solution are comman, and if the amount of such matter exceeds 40 or 50 grains per gallon, priming is almost sure to occur. Other waters may not inherently possess foaming qualities, but when treated, in order to prevent incrustation (as with waters containing sulphate of lime or magnesia) the soluble salts remaining in solution constitute a distinctly foaming characteristic. In such cases it is of great importance that some relief be provided.

The desired characteristics of a by-pass valve are: (1) It must be positive in action. (2) It should be large enough to permit satisfactory operation at high speeds. (3) It should be simple in construction and automatic in action. (4) It should reduce the vacuum to a minimum, thus preventing the suction of cinders into the steam-chest. (5) It should relieve water and excessive compression in the cylinders, thus preventing breakage and overheating, with its consequential difficulty of lubrication when desirable to drift "hooked up" in order to equalize the wear on eccentrics. (6) It should exclude cold air from the valve chest and cylinder. (7) It should reduce the draft on the fire when drifting. (8) It should be low in cost.

There are several arrangements which fulfil all or most of these requirements. The apparatus used by the Southern Pacific and illustrated in last year's report, is in successful operation on that system, and show a reduction of 50 per cent. in the braking power of the pistons, due to the lower vacuum and compression. The device is automatic, being thrown out of action by steam pressure in the dry pipe when the throttle is open, and allowed to operate when the throttle is closed. The water is released by a separate safety valve.

The Central Railroad of New Jersey has experimented with the valve illustrated in Fig. 3, and which is intended to relieve excessive compression. When the throttle is open steam pressure seats the valve in addition to the spring, and when the throttle is closed the spring only is operative. This spring was originally intended to allow the valve to open with 15 lbs. excess pressure in the cylinder, but the continual blow was so objectionable that the pressure as regulated by the spring was increased to 38 lbs. The relief from the valve was allowed to blow into the atmosphere, but it could be piped into the stack.

The report is signed by Wm. McIntosh, Chairman; J. A. Pilcher, H. F. Ball, G. R. Henderson, C. B. Young.

LOCOMOTIVE FRAMES.

The circular of inquiry brought out from the members a generous response, giving, in considerable detail, opinions and experience, accompanied by drawings locating fractures, with statements as to the probable causes. The study of this material is interesting, but unfortunately the information is so varied and the location of the fractures so distributed, it is very difficult to analyze or reduce them to any common law or base. The committee endeavored to construct a composite drawing, but had to abandon the idea. The breakages reported show cracks in and about all pedestal jaws. The fractures occur as frequently in the solid parts as through the bolt holes.

The preference of the members as to whether wrought iron or cast steel should be used is given as follows:

Total number of replies	41
Roads favoring steel frames	18
Roads favoring hammered iron	15
Roads expressing no preference	8
Based on the Number of Locomotives.	
In favor of steel, representing	11,512
In favor of iron, representing	5,613
Non-committal, representing	4,015
Total locomotives	21,140

The causes of fracture may be classified as follows: (a) Design. (b) Imperfect welds and faulty material. (c) Inertia of the boiler with reference to the frames, augmented by high cylinder saddles and accompanying high center of gravity of the boiler; the fractures showing mainly between the cylinders and front driver. (d) Presence of water in cylinders, when accompanied by arrangement of valves that prevents the water getting away quickly and freely. A discussion, bearing mainly on point (c), furnished by one of the members, is as follows:

"There seems to be no question but that the fractures are usually between the cylinder saddle and the rear of the first pedestal, but it should be further determined whether or not the cracks start from the bottom of the rail. If they do, then the bending moment due to the inertia of the boiler when the motion of the frame is suddenly arrested cannot be a cause of failure, because the bending moment induced by such force would put the top of the rail in tension and the bottom in compression, and the crack would, therefore, start from the top, as previously explained, except when coupling. If they start from the corner of the pedestal it is reasonably certain that the failure is caused by a loose bolt or light design of pedestal binder. It is very probable that the binder bolt will show a very much larger percentage of failures extending in the corner of the pedestal to the top of the rail than the clip pedestal brace, because of the difficulty of securing a bolt sufficiently large to prevent it stretching in service. Those failures which occur in the front of the pedestal cannot be assigned to this cause (unless the pound would strain the frame in a place of weaker section), and in failures of this nature the design of cylinder fastening and keys should be thoroughly examined. It might be well to point out that the bending moment induced by the pull of the drawbar would be at a maximum at a point between the front pedestal and the front cylinder. A stress from such a cause would start a crack from the bottom of the rail. If the frames break from a definite load or fiber stress, then a good grade of cast steel should give equal if not better results than wrought iron, and the steel should be of a moderately stiff grade. If, on the other hand, the frames break by a definite amount of distortion or bending, then wrought iron or soft steel would give better results, inasmuch as it would take a smaller force to bend this material a certain amount and the fiber stress induced would therefore be considerably less in the case in which the stiff steel is used."

Fiber Stress Analysis by H. V. Wille.

The inertia of the boiler in accelerating or retarding the train has also been given as a possible cause of breakage. Since frames never start to break from the top but always from the bottom of the rail, it is evident that the inertia of the boiler while the train is being retarded cannot be a cause of fracture, but the bottom of the rail is put in tension in overcoming the inertia of the boiler while the train is being accelerated. The stress produced by this force is as follows:

Weight of boiler = 57,000 lbs. . . . . = W
Acceleration = 5.655 ft. per second. . . . . = a

$$\text{Force } \frac{57{,}000 \times 5.655}{32.2} = 10{,}010 \ldots\ldots = F$$

Center of gravity of boiler above center of frame 56 inches. . . . . = d
Bending moment = 56 × 10,010 = 560,560 inch lbs. . . . . = M
Moment of resistance. . . . . = 103.5

$$\text{Fiber stress} = \frac{560{,}560}{103.5} = 5{,}416 \text{ lbs. per square inch.} = f$$

This is well within safe limits and is not sufficient to cause the frame to break. When the train is being retarded by application of brakes the top of the rail is being strained in tension by this amount, but when the train is being accelerated the bottom of the rail is being strained, and other forces also tend to increase the stress due to the force necessary to accelerate the boiler.

Assume that the frame is deflected by force of blow. Deflection = a = .1 in. Length = e = 41 in. from center of cylinder to fillet in front of front pedestal.

$$f = \frac{3d\,Ea}{e^2} = \frac{3 \times .10 \times 30000000 \times 3\,625}{41^2} = 19{,}600 \textit{ lbs. per sq. inch.}$$

Side bending. Compression increased by steam pressure on other side: 350 lbs. per sq. in. compression; 200 lbs. per sq. in. steam on other side; 550 lbs. per sq. in. equals 308,000 lbs. total pressure; 23.5 lbs. = moment arm; 308,000 × 23.5 = 7,238,000 in. lbs. = bending moment; 1,650 = moment of rupture through section of smoke-box and frames; 4,390 lbs. per sq. in. = fiber stress.

Effect of rounding curves. The centrifugal force of the weight carried by the front drivers: 16 degree curve = 358 ft. radius; speed 30 M. P. H. = 44 ft. per sec.; weight on journals = 41,000 lbs.

$$F = \frac{W\,V^2}{g\,v} = \frac{41{,}000 \times 44^2}{32.2 \times 358} = 6{,}888 \textit{ lbs.}$$

Moment arm = center of pedestal to first bolt in cylinder connection = 37.75; bending moment = 6888 × 37.75 = 260,000 in. lbs.; moment of rupture = 37,675; fiber stress = 7,960 lbs. per sq. in.

From the above calculations the following conclusions may be drawn:

(1) The inertia of the boiler following the sudden application of brakes cannot produce a sufficient force to break the frame. (2) The inertia of the boiler due to the acceleration of the train by acting with other forces, such as those produced by water in the cylinders, may bring about fracture. (3) The dynamic effect of the compression of water in the cylinders is the only force which, unaided, can cause failure of the frames by fatigue.

When the right side leads, the right side always pounds harder than the left. This is due to the fact that when the right crank passes the forward dead center the left cylinder is pulling forward so that it aids the right cylinder in throwing the right box

against the back jaw of the pedestal. The same is true on passing the back dead center, but when the left crank passes the forward center the right cylinder is pushing on the pin, thus subtracting from the left cylinder in pushing the left box against the back jaws of the pedestal. This should result in breaking more right than left frames when the right side leads and vice versa when the left side leads.

The committee took the liberty of inviting manufacturers to take part in the deliberations. The steel casting representatives examined and approved the frame designs accompanying the report (not shown herewith) and also held independent meetings, agreeing on the following specifications:

Acid open-hearth steel, .28 carbon, .05 phosphorus, .05 sulphur, .60 manganese; tensile strength per sq. in. not less than 55,000 lbs.; elongation in 2 in. not less than 15 per cent.; all frames to be annealed.

Relating to the method of manufacture, a member contributes as follows:

"The method of casting, location of gates and headers, all have a very important part upon the life of the frame. It is the usual practice to cast the frame on an incline, the front end of the frame being at the top, the metal being poured into a riser at the back end of the frame, which is at the lowest point. This method results in washing the dirt and gases to the front end of the frame, and we have defective metal at the point at which the frames are most prone to break. It would therefore seem desirable to reverse this method and mold the frame so that the front end is at the lowest point and pour them through a gate leading into the two front rails. It would also seem inadvisable to place the riser at the point of the juncture of the pedestal leg to the top rail, so as to avoid any impurities separating at this point and prevent shrinkage cracks due to the different rates of cooling of the risers and of the frame section proper. It would no doubt be an improvement to locate the riser on the pedestal at a point between the top and bottom rail."

The following points should be observed: (1) Sensible design. (2) Material, cast steel, made to a rational specification, careful foundry manipulation, adequate and suitable annealing. (3) Provide such form of bracing as will prevent "weaving." By weaving is meant a movement of one side independently of the other, or of the separate parts or joints, with reference to each other locally. (4) The clip form of pedestal binder is preferred to the thimble and bolt type. (5) Provision for quickly and adequately draining cylinders. This point is just as important with slide as with piston valves. (6) Frames with single front rails should be made stronger and means provided to stiffen same back of cylinders or between cylinders and front driver.

From a study of the replies for the present at least, there is an intimation that the double front rail type is stronger, and stiffer in a vertical direction, and yet as flexible longitudinally as the single front rail form. The success foreign roads are having with plate or girder frames gives us a hint that may be valuable when scheming on future improvements.

The report is signed by T. S. Lloyd, Chairman; S. M. Vauclain, J. E. Sague, R. Wells, S. Higgins, A. Lovell.

DRIVING AND TRUCK AXLES AND FORGINGS.

The committee last year reported a specification for locomotive axles and forgings, but was continued for the purpose of co-operating with the American Society of Mechanical Engineers, American Institute of Mining Engineers and the American Society for Testing Materials with a view of bringing about a common standard for specifications for locomotive axles and forgings. In accordance with this purpose a meeting was held which was attended by Prof. H. W. Spangler, chairman of Committee on Specifications, American Society of Mechanical Engineers; Wm. R. Webster, chairman of Committee on Specifications of the American Society for Testing Materials, and by members of the committee. It was agreed at this meeting to modify the specifications proposed last year by reducing the reduction of area to 25 per cent. and introducing a bending test. This modified specification is now before the American Society of Mechanical Engineers and will be proposed to the American Society for Testing Materials at their next meeting with the expectation that they adopt it as their standard specification for annealed high carbon steel forgings.

It has been proposed to omit the tension tests on the specifications for steel blooms. The committee feels that this test is essential in order to insure that the mills put sufficient work upon the blooms, for nothing tends to increase the failures or breakages of driving axles more than the use of steel which has not received proper manipulation.

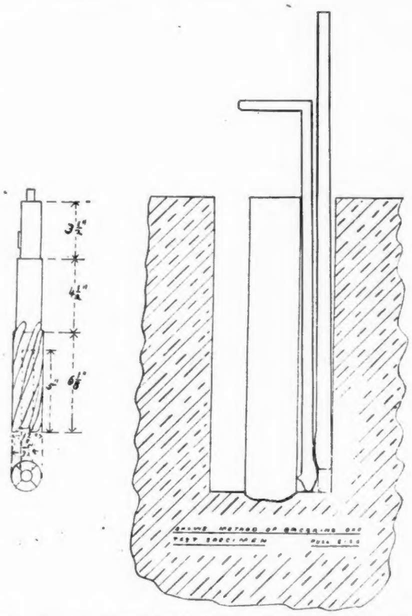


Fig. 1—Tool for Obtaining Test Specimens from End of Driving Axles.

The reduction in strength with holes drilled half way between the center and outside and also with a hole in the center is shown in the following table:

Diam. of Axle.	Hole in Center. Per Cent.	Hole Half Way Between Center and Outside. Per Cent.
6 inches	1.35	15.3
7 inches	.71	10.9
8 inches	.41	8.2
9 inches	.25	6.1
10 inches	.16	5.0
11 inches	.11	4.1

If the hole is drilled to within 1½ ins. of the inner side of the hub it will have no effect upon the strength of the axle.

The specifications proposed last year would stand as follows with the modifications now proposed.

Material.
Open Hearth Steel.
Chemical Requirements.

	Per Cent.
Phosphorus, not to exceed	.05
Sulphur, not to exceed	.05
Manganese, not to exceed	.60

Physical Requirements.

Tensile strength—not less than 80,000 lbs. per sq. in.

Elongation in two inches, not less than 20 per cent.

Reduction in area, not less than 25 per cent.

Bending test—1 in. x ½ in. test piece 180 degrees over 1 in. diameter.

One test per melt will be required, the test specimen to be taken from either end of any axle with a hollow drill, half way between the center and the outside, the hole made by the drill to be not more than 2 ins. in diameter, nor more than 4½ ins. deep. The standard turned test specimen, ½ in. in diameter and 2 ins. gage length, shall be used to determine the physical properties. Drillings or turnings from the tensile specimens shall be used to determine the chemical properties.

A method of breaking off test specimen and the tool for obtaining it from the end of the driving axle are shown in Fig. 1.

Proposed specifications for locomotive forgings are as follows:

Material.
Open Hearth Steel.
Chemical Requirements.

	Per Cent
Phosphorus, not to exceed	.05
Sulphur, not to exceed	.05
Manganese, not to exceed	.60

Physical Requirements.

Tensile strength, not less than 80,000 lbs. per sq. in.

Elongation, not less than 20 per cent. in two in.

Reduction in area, not less than 25 per cent.

Bending test—1 in. x ½ in. test piece 180 degrees over 1 in. diameter.

Proposed specifications for steel blooms and billets for locomotive forgings are as follows:

Material.
Open Hearth Steel.
Physical Requirements.

Grade "A":
Tensile strength, 70,000 lbs. per sq. in.
Elongation in two inches, 20 per cent.

Grade "B":
Tensile strength, 80,000 lbs. per sq. in.
Elongation in two inches, 17 per cent.

Chemical Analysis.

Grade "A":	Per Cent.
Carbon	.25 to .40
Phosphorus, not to exceed	.06
Sulphur, not to exceed	.06
Manganese, not to exceed	.60
Grade "B":	**Per Cent.**
Carbon	.35 to .50
Phosphorus, not to exceed	.05
Sulphur, not to exceed	.05
Manganese, not to exceed	.60

Grade "A" is blooms or billets for rod straps and miscellaneous forgings. Grade "B" is blooms or billets for driving and truck axles, connecting rods, crank pins and guides.

The report is signed by F. H. Clark, Chairman; J. E. Sague, S. M. Vauclain, L. R. Pomeroy, F. W. Lane, E. B. Thompson.

GRATES FOR BITUMINOUS COAL.

(From a paper by J. A. Carney.)

It has been demonstrated that the cheapest fuel for locomotive use is that which can be bought for the lowest prices per ton, and it rests with the railroad mechanical engineer to so design his engine to burn this cheap fuel with the least inconvenience. The ash pan is so closely related to the grate that it is discussed in this paper in connection with grates. In designing a grate the first object is to properly support the fire; the second, to admit air enough to the fire to properly burn it; the third, to easily and effectually stir the coals and shake down the ashes, and the fourth, to be able to quickly remove the fire at the end of a run; a fifth and most important feature is to be able to

quickly and easily clean the fire on the road.

The ash-pan must be tight to prevent loss of hot ashes, and yet have enough openings to admit air freely to the under side of the grates. It must have sufficient volume to carry ashes made during a trip of many hours, and should dump and clean itself with a minimum amount of labor. There should be no flat places where ash can collect and fill up to the grates. While the air openings, according to theory, need be very small, they should in practice be as large as possible and allow the passage of sufficient air to not only burn the fire but cool the grates and accumulations of ash on them as much as possible.

Estimating the temperature of the products of combustion in the fire-box at 3,500 degrees F., the volume of the gases passing out of the fire-box will be about seven times as great as the air passing through the grates, due to the expansion caused by the high temperature. As all of the gases have to pass through the flues, the openings in

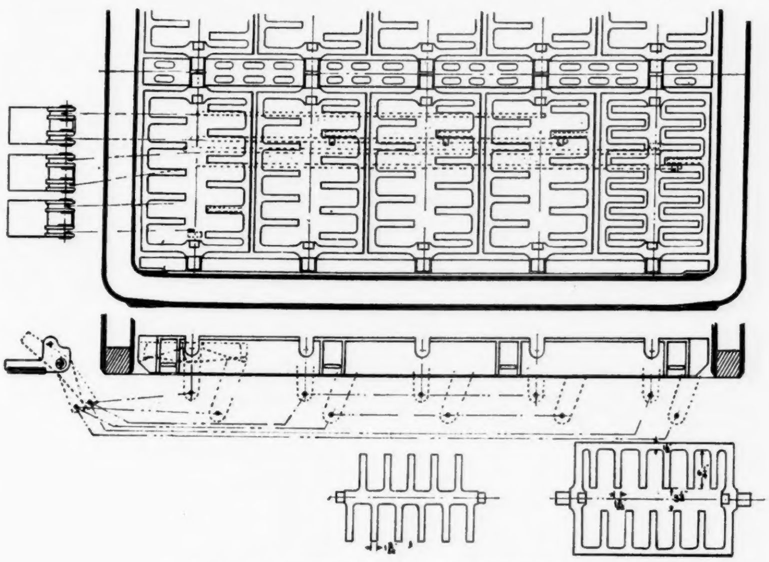


Fig. 1—Proposed Grate Arrangement.

the grates and ash pan need be one-seventh of the combined area of the flue openings. According to the above figures, an engine having 44 sq. ft. of grate area and 792 sq. ins. of flue openings, the total area of grate opening should be 114 sq. ins., with 114 sq. ins. opening in the ash-pan. In per cent., with grate area 100 per cent., this equals:

Grate area	100
Flue area	12.5
Grate opening	1.8
Ash-pan opening	1.8

Grates (Finger and Box).—The use of the finger grate is somewhat more common than the box construction. The box construction is used in good-coal districts, and while roads report some trouble where the coal is fairly good, others who are using poor coal report an endless amount of trouble. The fingered grate has the advantage of breaking up as well as stirring the fire, while the box grate can only lift and lower the fire, without breaking it up. The only objection to the finger grate is the possibility of burning the ends of the fingers if they are not kept level. This can be entirely overcome by care on the part of the fireman and the shaking mechanism kept in repair. The long-fingered grate is better adapted for poor coal than the short finger. It has a more violent action on the fire, breaks it up better, shakes down ashes faster and gives a larger opening through which the fire can be dumped in the least possible time. Grate fingers less than 5 ins. long do not give as good results with coal which clinkers or which fills up the box as those longer than 5 ins., although the general practice is to run under 4⅞ ins.

Dead Grates.—Dead grates are used by seven of the roads making replies. These roads use a better grade of coal than that found in the Middle West. As a general proposition, a dead grate is not advisable, especially in the front end of the fire-box, where there is most need of a good fire, especially with wide, shallow fire-boxes. It is easy to accumulate ashes in the front, and if the fire dies and cold air gets next to the flue sheet, it is difficult to make an engine steam.

Dump Grates.—Most roads have special dumping grates, both in front and in the back end of the fire-box, and the idea has a great deal of merit, especially when it is necessary to clean a fire on the road. These grates should be shaking as well as dumping grates.

Shaking Grates, Area.—Grates should be designed so that the entire grate surface may be shaken. If it is desirable to stir up the fire in the middle of the box, why not on the sides and especially the ends? The area shaken by one lever may vary with the quality of the coal, and if the ash melts and cements the grates tight, the shaking feature is out of the question and all designs are equally bad. The grate area shaken by one lever ranges from 7.2 sq. ft. to 29.8 sq. ft. The grates with the last-named area are used with West Virginia coal and practically no shaking is required. Generally speaking, the grate area to be shaken by one lever should not exceed 12 sq. ft. Some recently built engines have the grate lever fulcrum attached to the back of the boiler head with studs. These studs are liable to pull out and it is safer to attach the fulcrum to the deck or tailboard.

Grate Supports in Wide Fire-Boxes.—It is impracticable to make grate bars wide enough to extend from one side of a fire-box to the other without a central support. This support prevents air from circulating under the fire in the middle line of the box, and there is a dead space a few inches wide from the front to the back of the fire which will clinker badly if great care is not taken in firing.

Material.—Grates should be made of as cheap a grade of cast iron as can be bought and have the required strength. Hard iron is not an objection, if the cotter and pin holes are carefully cored. Patterns should be accurately made and the foundry required to furnish castings that do not require any machine work. Many roads are following the practice of coring all cotter and pin holes, with excellent results, and a great deal of labor and many small drills are saved thereby.

Proposed Grate.—A grate should be capable of dumping the front section and the back section independently of each other and the balance of the grate sections, and in addition all sections of the grates should be capable of dumping. Dead grates are not desirable, although they are the practice on many roads. All sections of the grate should be capable of being shaken, and the sections so divided up that not more than 12 sq. ft. of grate surface is shaken by one lever. Grates should be supported by bars on the sides of the fire-box only, and these bars should be blocked away from the side sheets at least ½ in., to prevent corrosion of the side sheets. The fingers should be from 6 ins. to 7 ins. long, depending on the length of the fire-box and the number of sections into which the grates are divided. The air openings in the grates should be at least 40 per cent. of the grate area and 50 per cent., if possible. A drawing of a grate arrangement as outlined is shown in Fig. 1.

Proposed Ash-Pan.—The ash-pan should be self-cleaning and have a free air opening of at least 25 per cent. of the grate area, divided equally on the four sides of the pan. No design of pan is suggested, because its form is so dependent upon the frame construction and location of back driving-wheel axle or trailer axle that a satisfactory pan on one engine would be impossible on one of different design. The use of netting over air openings in the pan is objectionable, and so far as possible should be avoided and inclined slats used.

TERMINALS FOR LOCOMOTIVES.

(From a paper by Robert Quayle.)

Weak Spots in Roundhouse Operation.—The following would come under the heading of the title:

Insufficient tracks for storing engines; poor coaling facilities or coalhouse too far from roundhouse; sandhouse badly located or inefficient; water supply improperly located or inadequate; cinder pits not long enough or so located that engines have to run a long distance after fire is dumped; cinder car track not depressed enough, causing unnecessary shoveling; lack of a wide-awake man outside, who should, while working as a hostler or in some other capacity, have supervision over clinker pit, sandhouse, coal shed and other men working in the vicinity; turntable too small or weak and not power driven, causing more time to be spent spotting engines and turning them than is absolutely necessary; a roundhouse too small to get engines inside and close the doors, or one that is improperly lighted and ventilated; a poor roundhouse foreman; a poor engine inspector; washout facilities not arranged to wash out with hot water, or to have at least a pressure of 100 lbs. per sq. in.; drop jacks that won't drop; cinder floors; poor method of giving out work and checking it up; poor discipline among shopmen; a machine shop stocked with obsolete tools, or so located that men waste time running back and forth; a storehouse minus necessary material; a heating system that won't heat properly.

Organization.—There should be a good, live foreman in charge, who is responsible to the master mechanic. All of the men

working inside and out should be amenable to his orders; such a man, if a firm disciplinarian, and one who has the good will of the men and is quick to think and act, is invaluable. Under him should be an assistant who is familiar with the engines, enginemen and workmen; it should be his duty to give out the work and see that it is properly done, keeping check of the men who have done the work, so that in case it becomes necessary at some future time to locate them there would be no difficulty in doing so.

A good staff of machinists, boilermakers, truckmen, helpers, boiler washers, wipers, engine inspectors, etc., is indispensable, all having their duties outlined so that there will be no friction in promptly doing the work. Fair and straightforward treatment of the men will in return get, in most cases, cheerful service. Proper records must be kept of the numerous peridoical inspections that are called for. The engine-house in and out register should be entered up daily, and a check of engineers and firemen who are laying off or sick is useful to locate and round up men in case of a shortage.

(Other reports are held until the next issue.)

Train Despatchers' Convention.

The convention of the Train Despatchers' Association of America was held at St. Louis on Tuesday, June 21, in the old Exposition building. Thirty-three new members were elected. The report of the Executive Committee showed a net gain of 71 members during the past year and a total membership of 850; a balance of receipts over disbursements of $510, and $1,651 in the treasury.

The report of the Train Rules Committee was read. It took up several matters referred to it from the committee report of the preceding year and embodied suggestions for submission to the American Railway Association amending the definitions in the Standard Code of "Regular Train," "Superior Train" and "Schedule," Rule 4 (A), Rule 4 (B), Rules 20, 218 and 220; Form E, Form F, and Form K, with the view of making clearer the distinction between a regular train and a schedule, and of defining the action of sections affected by a Form F order in the matter of taking down signals, which it was the judgment of the committee were not sufficiently well defined in the Standard Code as it exists.

Papers were read from J. R. Cavanaugh, Superintendent of Car Service of the C., C., C. & St. L., on the subject of "Pooling Freight Cars"; on "Train Despatching," by S. H. Brown, of the Chicago & Alton, and on a "Schedule and a Train," by H. A. Dalby, of the Northern Pacific, all of which were followed by considerable animated discussion. The report of the Train Rules Committee was adopted with some slight changes and was ordered submit d, as revised, to the American Railway Association.

Informal discussion was had on a number of subjects relating to train rules and forms, telegraph block signaling and manual controlled signaling. The publication of the official organ of the Association, "The Train Despatchers' Bulletin," was ordered continued at its present size, 40 pages per issue. A resolution was passed authorizing the Executive Committee to draw on the treasurer for a sum not exceeding $100, in aid of the widow or orphans of a deceased member who are in need. Members were urged to be more prompt in notifying the secretary of actual or impending vacancies, so that members out of employment might be more effectually aided.

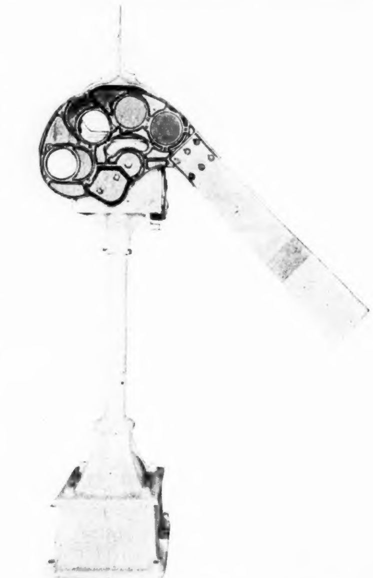
The election of officers resulted as follows: President, John W. Culneen (L. V.), Auburn, N. Y.; Vice-President, F. X. Meyers (T. & P.), Marshall, Tex.; secretary-treasurer and editor, J. F. Mackie (C. R. I. & P.), Chicago. Denver was selected as the place of next annual meeting, which comes on June 20, 1905. The sum of $100 was appropriated toward the expense of entertainment at the next annual meeting.

Thursday afternoon was devoted to a trip over the lines of the St. Louis Terminal Railroad, for the purpose of examining its interlocking and signaling plant. The trip was very interesting; many of the members had never before seen a plant so extensive.

There were 66 members in attendance at the various sessions of the convention, and great interest was taken in all the proceedings.

Herman's Direct Driven Semaphore Signal.

The engraving given herewith shows the latest electric motor for semaphore signals brought out by Mr. R. Herman, of Crafton, Pa. This motor is fixed to the top of the signal post and is so designed that it can be attached to any post. Where a motor signal is to be put in place of a mechanical



Herman's Electric Semaphore.

signal, which is supported on a wooden post, the old signal can be removed, the post sawed off square just below the top, and the new signal put on, without any other changes. Where necessary, the socket can be made any size or shape desired.

This is the signal of which a test was reported in the *Railroad Gazette* of June 10, page 447. The motor is connected directly to the spindle which turns the blade, and as there is only one moving part the blade moves as soon as the motor is energized. Doing away with the heavy connections between the motor and the signal, which are necessary when the mechanism is at the bottom of the post, and with unnecessary friction, reduces the demand on the power about two-thirds. The disuse of the large mechanism box at the foot reduces the size of the foundation, and where signals are placed on bridges the unsightliness of the mechanism box is done away with.

The power used to make the movements in the test referred to was 20 cells of Gordon battery, Type A, 300 ampere-hour. The motor was controlled by a signal magnet of 1,000 ohms, which was closed 25 seconds each minute and consumed 12 miliamperes each period, making the consumption of energy 300 miliampere-seconds per movement. The track relay, of 4 ohms resistance, was energized by two gravity cells connected in multiple, and the shunting was done by a Seth Thomas clock.

The signal made a movement of 90 deg. each time the circuit was closed (every minute). The arm is held at stop by a locking device; this in the test consumed 32 miliamperes for 35 seconds, or 1,120 miliampere-seconds per movement. The motor consumed 2.4 amperes per movement and the movements averaged five seconds. The batteries were put into service at 6.45 p. m. on March 15, and moved the signal every minute until May 4, when the automatic recorder had registered 73,100 movements. The battery then dropped to 7 volts on closed circuit, that is, connected through the signal. Then the batteries were given a rest of 12 hours when they showed 15 volts on open circuit. They were subsequently connected again twice, making the total number of movements 74,100; and they still showed 15 volts when the test was closed. The efficiency of the battery proved to be about 94 per cent. The cost of renewing the battery is $20, so that the average cost of each of the 74,100 movements would be .0257 cents. The weight of the semaphore casting and blade used was 115 lbs.

This motor is not geared direct to the signal but moves it by means of an electric clutch. Thus the mechanism is never turned backward, and the signal, in moving to the stop position, is entirely independent of the motor apparatus. The average speed of the motor in the test was about 2,600 revolutions per minute.

Fpreign Railroad Notes.

New signal and train rules have been prepared for the Austrian and Hungarian railroads, to go into effect May 1, 1905. The innovations are a general adoption of space instead of time intervals between trains and the requirement of continuous brakes for all trains running as fast as 60 kilometers (37 miles) per hour. Trains will be permitted to have two pulling and two pushing engines, and a "safety car" (interposed between the locomotive and the first passenger car) will no longer be required on trains which do not exceed a speed of 28 miles an hour. The telephone may be used to report the passage of trains; distant signals are to be used before main signals; red lights must always mean stop, and not be used on trains standing at stations which are to be passed or met by other trains, etc.

The Hungarian Minister of Commerce has addressed to the employes late on strike a circular which says that the great material damage caused by the strike and the blow to the good reputation of the nation and the State railroads cannot soon be made good; and only by the strictest attention to duty can the former reputation be acquired again. He has no intention of adopting repressive measures toward those who have returned to their duty; but those who directed the movement of the employes into criminal courses must be left to take the consequences which the courts may find them to have incurred. Faithful service hereafter will cause the government to do all it reasonably can to improve the condition of the employes.

Besides the four long tunnels, with an aggregate length of nearly 17 miles, which are being excavated for the new Austrian Alpine railroads, there will be a great number of smaller ones, whose aggregate length is nearly as great. Hand drills are used on these smaller tunnels.

GENERAL NEWS SECTION

THE SCRAP HEAP.

The Wabash road, which expects to open its line to Pittsburg this week, announces round trip rates to St. Louis from $1.55 to $2.40 less than the excursion rates by the other railroads.

At the suggestion of J. E. Duval, the Canadian government inspector of railroad accidents, the different railroads of the Dominion will draw up a standard set of rules for the operation of trains, which will be submitted to the Railway Commission for approval. The Standard Code of the American Railway Association will, no doubt, form the basis of the Canadian code.

A press despatch from Philadelphia says that the Baldwin Locomotive Works will within a few days discharge 4,000 men, reducing the total working force of the shops to about 6,000. At the time of heaviest business a few months ago these shops employed 16,000 men. The press despatch adds that 300 of the men recently discharged will be put in the places of stay-bolt men in the boiler shops, who struck last week.

At the shops of the Illinois Central, in Waterloo, Iowa, last week, the workmen had their pay handed to them at their benches, or other places of duty, the assistant paymaster and a clerk connected with the shops going about for this purpose. This plan is being tried with a view to avoiding the disturbance and loss of time incident to the former plan of having the men leave their work for a half hour, more or less, to go to the pay car.

It is announced in the New York daily papers that the New York Central is going to carry passengers from New York to Albany at about a cent and a half a mile. This arrangement applies on only one train, and it is over the West Shore division. Passengers leave by the Franklin and the Forty-second street ferries at 8 and 8:15 p. m., respectively, and the fare is $2. The same rate applies southward on the corresponding train. The distance from Weehawken to Albany is 141.3 miles.

Railroad Disaster in Spain.

A press despatch from Madrid, June 23, reports the wreck of a passenger train in the Province of Teruel, in the mountains northwest of Valencia, in which 30 persons were killed. It appears that the train was derailed on a bridge across the Jiloca river, and the cars and bridge took fire.

Automatic Block Signals.

The Hall Signal Company has taken a contract to install automatic block signals on the Illinois Central between Fulton, Ky., and Memphis, Tenn., 120 miles, double track. Also, contracts for similar signals on the Lake Shore & Michigan Southern from Brocton, N. Y., to Erie, Pa., 39 miles, and from Indiana Harbor, Ind., to 100th street, Chicago, about 10 miles.

Board on Wireless Telegraphy.

The President has appointed a Board to consider the question of wireless telegraphy in the Government service, of which Board Rear Admirals Robley D. Evans and Henry N. Manney, U. S. N., Brig.-Gen. A. W. Greely, U. S. A.; Lieut.-Commander J. J. Lane, U. S. N., and Prof. Willis L. Moore are to be members. The Board will decide which department of the Government should have control of wireless telegraphy as applied to the Government service and will also make an inquiry into the various systems now in use to select one that will work interchangeably with all the best apparatus of the systems now used on shipboard, and will report its findings to the President.

Inquiry About English Railroad Rates.

Certain correspondence has lately passed between the British Board of Agriculture and Fisheries and the railroad companies in Great Britain, as to the rates for carriage of agricultural produce, etc. The detailed points dealt with in the correspondence need not be discussed, but the result is a proposal on the part of Lord Onslow to appoint a Departmental Committee for the following purposes: To inquire as to the rates charged by railroad companies in Great Britain in respect of the carriage of foreign Colonial farm, dairy and market garden produce from the port of shipment or of arrival to the principal urban centers, and to report whether there is any evidence to show that preferential treatment is accorded to such produce as compared with home produce, and if so, what steps should be taken, either by legislation, or otherwise, to secure the better enforcement of the law in the matter.

C. P. R. Telegraph School.

A school for teaching telegraphy, stenography and typewriting has been established in Montreal by the Canadian Pacific Railway. The students who may attend will be employees of the company, it having been decided that in all positions pertaining to operation on the road, men with a knowledge of telegraphy shall be favored. Three teachers, one for each department, will have charge of the classes, which meet two or three times a week. To insure steady attendance the company has decided to charge each pupil two dollars a month for a term of six months; or longer, if the teacher thinks a pupil is not competent to undertake work after the half year term. If a pupil attends 80 per cent. of the classes during such period the money will be refunded at the completion of his course. There are many pupils attending the classes, which have just been opened.—*Montreal Gazette.*

Electric Roads Bought by the Canadian Pacific and the Grand Trunk.

The Canadian Pacific is reported to have bought the Niagara, St. Catharines & Toronto Railway, and the Grand Trunk has purchased the Hamilton, Grimsby & Beamsville Lake Railway. The Niagara, St. Catharines & Toronto was originally a steam road, and was converted to electric traction some years ago. It has private right of way and operates a through freight service in connection with the steam roads in the same territory. More than fifty manufacturing establishments along the line have side tracks, and the company has done a profitable business in handling freight in carloads. The Hamilton, Grimsby & Beamsville, which has been bought by the Grand Trunk, is 23 miles long and extends from Hamilton to Beamsville, through a rich agricultural country. It is in first-class condition and has developed a considerable freight business.

Protection of Canadian Forests from Fire.

In accordance with the policy of protecting the timber resources of the Province from destruction by fire, the Provincial Government of Ontario has inserted two special clauses in the agreements with railroad companies building lines through the new districts. One of these reads as follows: "It is agreed that wherever the line of construction runs through lands of the Crown which are not covered by timber license, the Government shall be at liberty to provide protection of the forest adjacent to the line of construction by placing on duty a staff of fire rangers for the protection of timber. All expenses incurred thereby shall be borne and paid for by the railroad." The other clause makes a similar provision as regards the protection of timber under license. The control of the fire protection system is thus retained in the hands of the Crown Lands Department. The fire-ranging system, which has been in operation already in connection with railroad construction along the line of the new Temiskaming & Northern Ontario, has been highly satisfactory.

Superintendent Forepaugh.

Mr. J. L. Forepaugh, Division Superintendent of the Great Northern, at Breckenridge, Minn., has been complained of in a letter sent by business men of Breckenridge to General Manager Ward on the ground that—

> "he . . . seems to have conceived the idea that his mission was to disorganize our municipal government and destroy our mercantile and other concerns. He has deemed it proper to browbeat and intimidate your employees into attacking the existing order of things and has turned our community into rancorous, bickering factions, as a result of which our business is suffering and the end is not yet."

And if he is not ordered by the company to attend to his own business the complainants are going to send their freight by the Chicago, Milwaukee & St. Paul. As the wording of this accusation is somewhat vague and general, the reader who wishes to learn what it is all about must turn to the reply which was sent by General Manager Ward, which says:

> "I beg to say that all the signers of your petition, with two exceptions, are saloonkeepers or men interested in the liquor business. I have no hesitation whatever in saying that if Mr. Forepaugh has succeeded in incurring the opposition of men of this class, whose greatest interest is in promoting the drinking habit among the citizens of Breckenridge, of whom so large a percentage are our employees, he has given us the very best reasons why he should be continued in his present position. The Great Northern Railway is very strongly opposed to a continuance of the low state of public morality that has for so long a time existed in Breckenridge."

Philadelphia vs. Montreal.

Philadelphia's chances for participation in the limited grain export business which the collapse of the Lake vessel men's strike makes possible at this season of the year are practically nullified by an advantage of fully two cents a bushel in freight rates to Montreal over the lake and rail rates to this port. Hancock & Co., who are the only survivors here of the big exporting houses driven out of business by the prolonged stagnation of the export grain trade, have

written, within a day or two, to all the leading steamship and railroad companies and to the New York Produce Exchange, protesting against the continuance of conditions which handicap the business not only of Philadelphia, but of New York and other Atlantic ports as well.

It has been pointed out by this firm that corn can be taken from Chicago and landed free on board steamers at Montreal at four cents a bushel, while existing lake rates to Buffalo and thence to Philadelphia, with terminal charges added, make the cost six cents a bushel. In the face of this fact the temporary suspension of the four-tenths of a cent ex-lake differential in favor of this port, pending the final decision of the general question of differentials by the Interstate Commerce Commission, is a minor obstruction to trade. It would be a serious one if its importance were not overbalanced by the greater difference of two cents accorded to Montreal via the Canada Atlantic Railroad from Georgian Bay.—*Philadelphia Record.*

Large Irrigation Projects.

The Secretary of the Interior has withdrawn from all forms of settlement 1,013,760 acres of land in the North Platte district in Nebraska for use in the irrigation plans, for which $1,000,000 has been set aside.

The preliminary stage of reclamation work has been completed and the following amounts set aside for the various projects named, which have been approved by the Secretary of the Interior:

"Arizona. Salt river project.—Under consideration, at estimated cost of about $3,000,000.

"California. Yuma project—Approved construction by Secretary, at cost of about $3,000,000.

"Colorado. Uncompahgre project—Involving an expenditure of $2,500,000.

"Idaho. Minidoka project—For which about $2,600,000 has been provisionally allotted.

"Montana. Milk river project—General allotment of $1,500,000.

"Nebraska. Reclamation of lands along North Platte river, for which $1,000,000 has been set aside.

"Nevada. Truckee-Carson project—Under construction, at a cost of about $3,000,000.

"New Mexico. Hondo project—At a cost of approximately $350,000.

"North Dakota. Fort Buford project—Taking water from Yellowstone river, in Montana, at a cost of about $1,200,000.

"Oregon. Malheur project—Costing about $2,000,000.

"South Dakota. Bellefourche project—Costing about $2,100,000.

"Utah. Conservation of water in Utah lake at a cost of about $1,000,000.

"Washington. Reclamation of land near Pasco, at a cost of $1,500,000.

"Wyoming. The storage and diversion of Shoshone river, near Cody, for which $2,250,000 has been set aside."

The King of the Ticket Brokers.

Adolph Ottinger, the new president of the American Association of Ticket Brokers, has just served a two days' jail sentence in San Francisco for contempt of court in violating an injunction restraining the brokers from dealing in non-transferable contract railroad tickets. This circumstance, coming as it did close upon the heels of his election to the presidency of the association, has brought into prominence the peculiar position occupied by Ottinger in the railroad world. He is properly called the "King of the Ticket Brokers," for he owns or controls a string of some 30 scalping offices, reaching from San Francisco to Boston and from the Twin Cities to the gulf. During the past decade Ottinger has amassed a fortune. So ambitious has he become that he recently went to New York and made a proposition to the eastern railroad presidents to the effect that if they would recognize and deal with him alone he would within 12 months "drive all dishonest ticket brokers out of business." Theoretically, every railroad in the country is engaged in the war to exterminate ticket scalping; nevertheless Ottinger was elected president of his association, because he has the entry to the private offices of nearly all of the leading passenger men in the country, or at least in the West. This privilege which Ottinger enjoys is the result of dealings which he has had for years with one of the largest western roads. The railroad in question protects Ottinger's transactions in such a way as to gain materially in revenue at the cost of its competitors and at the same time enable Ottinger to continue amassing wealth and to laugh at the attempts of the protective bureau to exterminate scalping. Ottinger is now said to control possibly $2,000,000 worth of business annually, and, therefore, while smaller brokers are being hounded by detectives and sent to prison, Ottinger spends his time pleasantly wining and dining railroad officials and being wined and dined by them.
—*Chicago Record-Herald.*

Railroad Expense Statistics.

A president of a great system, referring to the increase in his expenses, expressed his complete helplessness in an effort to compare the figures of his road with those of any other, or one division of his road with any other division, or of even one division with another over the past four years of extraordinary improvement work. If figures are of such little certainty the whole statistical structure that railroads assume to rely upon is worthless and had better be discontinued. It was a former president of the same system who, in an earlier day of railroading declared that he needed no account but his cash account. His auditor and treasurer were one. All the general records of operation that were essential from day to day he carried in his hat. But this president could not handle a railroad to-day. The present incumbent has passed beyond the crude stage of this forerunner, but he probably has much to learn in the handling of railroad figures if he sets so little value upon them.

It is altogether too true that railroad statistics convey only vaguely their story, and sometimes result in confusion and wrong conclusions. It is also true that many of the railroad managers to-day who have reached the position of president, had their training at a time when statistics were not in vogue as they are to-day, and they have not learned how to handle them. It is doubtless too late for them to learn. We must expect a later generation to take hold of the subject more vigorously.

But as to statistics themselves, there is vast room for improvement. There is not a road in the country which has in any satisfactory way solved the problem of stating its expense account and holding operations in such shape that they can be inductively studied by comparison with any period, any division, or any road. It is but begging the question to urge that the conditions are different. It is these very differing conditions which statistics are designed to bring into profile. We can never see a sheet of paper unless we see the edge of it. We can only learn by contrast and comparisons. Transportation expense should be carefully set out under not less than the following heads:

A.—1. Traffic solicitation.
2. Rate bureaus and expense.
3. Outside agencies.
4. Commissions.
5. Advertising.
6. Superintendence.

B.—1. Freight train service, to include engineers, firemen, fuel and all supplies necessary for the running between terminals.
2. Passenger train service expenses, to include train service, engineers, firemen, fuel and all supplies necessary for running between terminals.
3. Roundhouse expenses.
4. Switch yard expenses.
5. Station expenses.
6. Keeping line open, to include all fixed expenses, tower operators, reporting station operators, crossing watchmen, and all service and expenses included in keeping the line clear, without direct reference to the number of trains which may be run over the road.
7. Train despatchers, to include all expenses for despatchers and copying operators.
8. Administrative expenses, to include staff of trainmaster's and superintendent's office, and finally marine operation, if there is any.
9. Superintendence.
10. Contingencies, accidents, etc.

In some such way the expenses should be set out so that the totals developed should bear some relation to the result which they produce.

No nicer study can be devised than the careful analysis of transportation expense along these lines. It is reasonable and fairly accurate for practical requirements.

Considering the vast amount of money involved, it is wonderful that managers have not addressed themselves with vigor to statistics. The statistician is not a low-grade man, who merely compiles figures and balances them in a total, but he is a man of wide range of view, large experience and candid judgment. He should so far as possible be exempt from the mere compilation of figures and the mere filing of tables in neat books.

A manager should lead out along the lines, his statistician's figures point to different arrangements of methods to produce largest output at the least cost. That road whose standards are not constantly held open to question, whose methods are rigidly fixed, has reached the stage of death stiffness, and it is time the stockholders inquired into its operation.—*Wall Street Journal.*

Penalty Per Diem Forms.

In order to expedite the movement and delivery off the line of foreign cars on which the penalty per diem rate of $1.00 per day is about to apply, the New York Central has recently made up and put in service a new set of forms, which are here shown.

Fig. 1, the Penalty Car Notice, is made up in the Car Accountant's office as applying to all cars for which penalty notices are received from owners. This notice, if the car is still on New York Central rails, is addressed directly to the agent or yardmaster having jurisdiction over the point at which the car is last reported as arriving. If the car referred to has left the station addressed before receipt of the notice, the instructions provide that the notice is to be forwarded to the agent at the point to which the car moved, loaded or empty; in short, this notice follows each movement of the car up to the junction where delivery is made to a connecting line; the date of such

delivery and the initial of the road to which delivered being noted on the form by this company's junction agent. The junction agent then returns the notice to the Car Accountant's office, where the information as to delivery of the car off the line is compared with the record in that office; the latter to insure the correctness of the book

New York Central & Hudson River Railroad Co.
CAR SERVICE DEPARTMENT.

PENALTY CAR NOTICE No. ____

New York, ____ *190*

Yardmaster
Agent ____.

____ *Car No* ____ *reported arriving at your station* ____ *has been on the road over 20 days, and, if not delivered to connecting line before* ____, *will be subject to a penalty charge of one ($1.00) dollar per day until such time as it leaves this line.*

____ *Station,* ____ *190*

Agent ____

Above car to you train ____ *Date,* ____ *190*

____ *Agent.*

____ *Station,* ____ *190*

Agent ____

Above car to you train ____ *Date,* ____ *190*

____ *Agent.*

Car Accountant,
New York,
Above car delivered ____ *R. R. at this station, Date* ____

____, *Junction Agent.*

INSTRUCTIONS.

If on receipt of this penalty notice, car has left your station, fill out upper portion of Form C. A. 335 and forward to Car Accountant, New York; also fill out the first of the blank forms above addressing same to agent at the point to which the car has been forwarded loaded or empty.

If car is still on hand, fill out lower portion of Form C. A. 335, sending to Car Accountant, New York, and forward this notice with first blank space above properly filled out when car leaves your station.

If notice is addressed to junction agent, the last blank form will be filled out by him and notice returned to Car Accountant, if the car is delivered connecting line at that point. This notice, is, in all cases, to follow the car until it is delivered to a connecting line, when the last of the blank forms above is to be filled out by junction agent, who will return same to Car Accountant. An agent receiving this notice before car has left his station, will also fill out upper portion of delayed car notice (Form CA-328) and attach same to duplex slip-bill to be forwarded with car, also, fill out two penalty car cards, (Form CA-142), and tack same on each car door. Form CA-335 must be made in duplicate, forwarding original to Car Accountant and duplicate to the Superintendent.

Agents, Despatchers, Yardmasters and others must use every possible means to have cars, subject to Per Diem or Penalty charges promptly released and loaded or moved empty to connecting lines before penalty becomes effective. The fact that car is under car service charges is not sufficient, and the freight, whenever possible should be unloaded, stored or transferred to a non per diem car and penalty charges obviated. Cars accompanied by slip-bills with "DELAYED CAR" notice attached, or, with "PENALTY CARDS" on sides, must be protected and delivered from line before date shown.

Fig. 1.

record from which the per diem owners is figured.

Fig. 2 shows "Reply to Penalty Notice" form. On receipt of penalty notice by each agent, successively addressed, this form is filled out in duplicate, the original forwarded to the Car Accountant's office and the duplicate to the division superintendent. If on receipt of the notice the car named has already gone forward, the upper part of this form is filled out by the agent, showing the destination of the car, and date forwarded. If, however, as is usually the case, the

NEW YORK CENTRAL & HUDSON RIVER R. R. CO.

PENALTY CAR

To avoid penalty this car must be delivered home road or connecting line on or before ____ **190**__

Home Route Via ____ **Station.**

To ____ **R. R.**

Agents or Yardmasters will see that these cards are removed from both sides of the car before delivering to connections.

TO BE TACKED TO EACH SIDE OF CAR ALONGSIDE DOOR.

Fig 3.

car is on hand under load, refused, unclaimed or for any other reason detained, the lower portion is used, showing with what commodity the car is loaded, to whom consigned, and why detained, also a statement as to when the car will probably be released and forwarded. This information keeps the car record office and the Superintendent's office in touch with all delayed cars and furnishes a basis on which to take action looking toward release.

To provide for the information of the yard men and others, a form of "Penalty Card" (Fig. 3) is furnished, which is tacked on each side of cars covered by penalty notices. The penalty notice is printed on parchment paper, making it possible to obtain a good carbon copy, which is kept on file in the Car Accountant's office. These copies are bound together in sets of 200 by the use of brass paper fasteners, the numbers of the notices running in consecutive order. As the replies (Fig. 2) are received from agents, they are pasted on the file copy and when original notices are returned showing delivery of car off the line, this information is also noted on the file copy. Thus a complete record of the handling of

New York Central & Hudson River R. R. Co.

REPLY TO PENALTY CAR NOTICE NO. ____

____ *Station,* ____ *190*

CAR ACCOUNTANT,
NEW YORK,

____ *Car No.* ____ *shown on above numbered notice was forwarded to* ____ *date* ____

Penalty notice forwarded to same point ____

____ *Car No* ____ *shown on above numbered notice is on hand loaded with* ____

consigned to ____

and is detained for the following reasons:

____

____

____

____

It is expected that car will be released and forwarded about ____

____ *Agent.*

This reply must be made in duplicate and carbon copy sent to the Superintendent

Fig. 2.

all penalty cars is obtained. By this means it is possible to take up all cases which show that a proper effort has not been made at any point toward the prompt handling of penalty cars.

Foreign Railroad Notes.

When the hard times struck Austria, the car-works (as usual under such circumstances) suffered especially. They petitioned the government to give out contracts for its supply of cars for five years at once, instead of for one year, "so that they might distribute the work more evenly." The request was granted, but as general business did not improve, naturally the shops got out of work again at last. The number of cars built by the eight Austrian works for three years and ordered for this year has been:

	1901.	1902.	1903.	1904.
Passenger	896	754	599	335
Freight	5,020	3,577	2,122	1,173

At the time that the advance orders were given we called attention to the danger of thus anticipating the demand. The result is that now the number of men employed is only about half as great as in 1901, and those still employed work only from 5 to 7 hours per day; and the works ask the ministry to increase its orders so that they may at least keep the force now at work employed through the winter.

The revival of business and traffic in Germany, after the depression which began after 1900, continues, but is less marked than last year, when the recovery began. In April, the gross earnings of all the German railroads increased 2¼ per cent. this year, following a similar increase last year over 1902. So the coal shipments from the mines in Prussia for the four months ending with April were 11 per cent. greater in 1903 than in 1902; this year they were 6¾ per cent. larger than last year. There is also a small increase in railroad earnings in France; but Austria seems to have as yet very little improvement in industrial activity. In Switzerland gross earnings have been nearly the same this year as last, but there has been a large increase in expenses.

Manufacturing and Business.

The Tula Iron Company, of Augusta, has been incorporated in Maine with a capital of $3,000,000. I. L. Fairbanks, of Augusta, is President and Treasurer.

The Bettendorf truck, described in the *Railroad Gazette* June 11, has been specified for 100, 80,000-lb cars now building by the Chicago, Milwaukee & St. Paul.

The New Britain Machine Company informs us that the chain mortising machine described in our issue of June 17 has a mechanical feed for the table. The feed is controlled by a foot lever.

The Hurley Track-Laying Machine Company, 417 Market street, Camden, N. J., has been incorporated, with a capital of $250,000, to build track-laying machines, by R. E. Hurley, M. L. White and John Svenson.

The American Oil Engine & Shipbuilding Company, of Portland, has been incorporated in Maine, with a capital of $6,000,000; W. M. Baldwin is President and H. E. Mason, of Portland, Treasurer.

The Kerr Turbine Company, of Wellsville, has been incorporated in New York to build workshops, etc., with a capital of $100,000, by C. B. Kerr, of Rutherford, N. J.; W. L. Ward, of Wellsville, and others.

The Traveling Stairway Company, of New York, has been incorporated, with a capital of $250,000. The directors are: D. M. Quay and T. R. Quay, of New York, and Edwin Baltzby, of Glen Echo, Md.

The Rockaway Rolling Mill, of Rockaway, has been incorporated in New Jersey, with a capital of $100,000, to operate heating furnaces and rolling mills, by George W. Sickle, T. H. Hoagland and Edwin Ehlers, of Rockaway, N. J.

The Wabash-Pittsburg Terminal Railway Co., it is reported, has given a contract to the American Bridge Co. for 2,500 tons of structural steel for the South Side elevated line at Pittsburg, to cost, with the erection, about $200,000.

The Broadway & Newport Bridge Company has been formed in Kentucky by the consolidation of the Broadway & Newport Bridge Co. of Ohio and the Newport & Broadway Bridge Co. of Campbell County, Ky., with a capital of $800,000.

The Lenoir City Car Works, of Lenoir City, Tenn., has been reorganized by C. E. Lucky, E. T. Sanford, J. A. Fowler, William Slattery and Samuel Marfield, with a capital of $100,000. The works are those recently sold by order of the Federal Court at Chattanooga.

The Eastern Steel Company, of Pottsville, Pa., it is reported, will build a power plant for the United States Navy Department, at Washington, and will start its bridge works on full time. The company has also under consideration the question of increasing its capital to nearly $10,000,000.

At the annual meeting of the United States Cast-Iron Pipe & Foundry Co., of Burlington, N. J., June 22, the directors whose terms expired were re-elected. The annual report of the company shows gross profits of $1,203,810, a decrease of $66,800, and net earnings $1,107,170, a decrease of $88,981. The surplus is $732,170.

The Crocker-Wheeler Company, Ampere, N. J., announces that it has retained Dodge & Day, Modernizing Engineers, of Philadelphia, Pa., and places their services, free of charge, at the disposal of its customers to assist them in adopting modern shop methods, to include all the problems of shop equipment and management.

A company composed of Richmond (Ind.) capitalists has been organized to make a patented lock nut under patents held by Charles Borden. The company has let a contract for a large brick building in West Richmond and has also contracted for a large amount of machinery. The capacity of the works will be about 40,000 lock nuts a day.

The Chicago Tool & Supply Company, Chicago, has been incorporated in Illinois for $15,000, to make the Green pneumatic hammer, the Hayes electric breast drill, and to deal in air compressors and all kinds of pneumatic tools, appliances, supplies, etc. The organizers are Geo. H. Hayes, Carl R. Green and F. W. Buchanan, formerly with the Chicago Pneumatic Tool Company.

The Niagara, Lockport & Ontario Power Company, of Lockport, N. Y., has increased its capital stock from $1,000,000 to $10,000,000 to build a power canal from the Niagara river under a State charter granted ten years ago. Stephen S. Palmer, of New York, has been elected a director in place of Thomas Oliver, and Charles Hickey, of Lockport, instead of Charles J. Perrin.

The Rand Drill Company has been awarded the contract for furnishing two large compressors to be used in the Central Air Power Plant eighteen miles below Sault Ste. Marie. They will supply air to operate 25 Little Giant rock-drills, four 3-ton cableways and four large water pumps. Their combined capacity is 6,600 cu. ft. of free air per minute. The work in hand is the construction of a two-mile channel in the Soo River, wide and deep enough for the navigation of large vessels.

Iron and Steel.

During May there was shipped through New York and other Eastern ports about 36,000 tons of steel billets, rails, bars, plates, hoops, iron plates, bar and pig iron for export, as compared with 20,817 tons in April.

The Illinois Steel Co., it is reported, has orders for upward of 90,000 tons of rails for 1905 delivery. The company's capacity is about 750,000 tons a year and its mills will probably be run on full time until February, 1905.

Improvements, it is reported, will be started at once by the American Sheet Steel & Tin Plate Co. at South Sharon to convert its works into a continuous mill, at a cost of about $500,000.

Reports from Birmingham, Ala., state that the Tennessee Coal, Iron & Railroad Co. has orders for rails now being made at its Ensley works from the Atlantic Coast Line which, with other orders, will keep its works busy for some time.

Large foundries in Pittsburg and east of that territory are preparing to bid on the castings for the East river section of the Pennsylvania tunnel, which, it is reported, will amount to about 108,000 tons. Pig iron producers are being asked for options on the necessary pig iron for delivery during the next two years.

The United States Steel Corporation has been investigating for some time the iron ore beds that it owns, and as a result of the investigation the quantity is estimated at 750,000,000 tons. This includes all the ore properties owned or controlled by the corporation, the larger of which are on the Marquette range, where there are 11 mines, eight of which are controlled by the corporation; on the Menominee range, where the corporation owns 12 of the 13 mines; on the Gogebic range, where five mines are owned by the corporation; on the Vermillion range, where there are six mines, and 29 mines on the Mesaba range, 26 of which are owned by the corporation. The total output of its mines on the Lake Superior region in 1902 was 16,063,179 tons, as compared with 15,363,355 tons in 1903.

PERSONAL.

—Mr. Ray Morris, Associate Editor of the *Railroad Gazette*, on June 29 received the degree of Master of Arts from Yale University.

—Mr. Walker D. Hines, First Vice-President of the Louisville & Nashville, has resigned his office and will take up the practice of law in Louisville. Mr. Hines' resignation takes effect July 15.

—Mr. Henry A. Rogers, of New York, President of the Board of Education of that city, and a prominent railroad supply man of New York City, died at his home in that city on June 25, at the age of 60.

—Mr. Lincoln Bush, Chief Engineer of the Delaware, Lackawanna & Western, received from the University of Illinois on June 8 the honorary degree of Doctor of Engineering (D. E.). Mr. Bush is a graduate of that university, class of 1888.

—Mr. John Henney, for many years Superintendent of Motive Power of the New York, New Haven & Hartford, has resigned. It is said that Mr. Henney, accompanied by Mrs. Henney, will take a European trip and upon his return will take up mercantile business.

—Mr. Frank N. Hibbits, who on Friday of this week goes from Washington to New Haven to succeed Mr. Henney, will have the title of Mechanical Superintendent of the New York, New Haven & Hartford. He is about 38 years old, and a brief sketch of his life was published in our issue of March 4, p. 166, at the time he became Consulting Mechanical Engineer of the Southern Railway.

—Mr. R. G. Curtis, who for the past few years has been Assistant Superintendent of the Northampton Division of the New York, New Haven & Hartford, has resigned on account of ill-health. Mr. Curtis has been connected with the Northampton Division, formerly the Canal Railroad, and later the New Haven & Northampton, for almost 50 years. For many years he was a conductor, then Assistant Superintendent, and for some time Superintendent.

—Mr. B. F. Frobes, Superintendent of Telegraph of the Oregon Short Line, is a native of Erie, Pa., having been born in that city 42 years ago. His first railroad work was as an operator for the Pennsylvania Railroad in 1877. Six years later he went West and took a place on the Union Pacific, where he remained until 1886. In that year he resigned and went to the Postal Telegraph Company, and afterward to the Western Union. In 1892 he went to Salt Lake and re-entered the service of the Union Pacific.

—Mr. W. P. Richardson, who has been appointed Mechanical Engineer of the Pittsburg & Lake Erie, is a graduate of the University of Minnesota, class of '99. He began railroad work as special apprentice on the Chicago Great Western and later became chief draftsman, where he remained until 1902, when he took a similar position on the Pittsburg & Lake Erie, from which position he is now promoted to be Mechanical Engineer.

—Mr. James Hardwell, Assistant General Freight Agent of the Intercolonial Railway (operated by the Government), has been appointed Traffic Officer to the Canadian Board of Railway Commissioners. His headquarters will be at Ottawa. Mr. Hardwell was born in England and began his railroad service on the Grand Trunk in 1874. He left that road in 1884 and took a position in the general freight department of the Canadian Pacific, where he stayed 14 years. He then went to the Intercolonial as Division Freight Agent, and soon was made Assistant General Freight Agent.

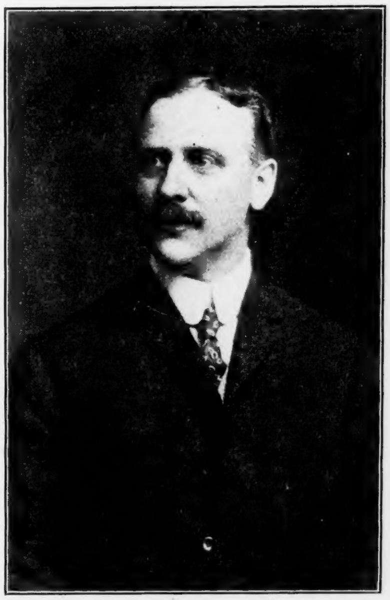
—Mr. E. M. Heigho, who recently succeeded Mr. Shelby as General Manager of the Pacific & Idaho Northern, was born in Essex, England, in 1867, and came to America when nine years old. His first railroad work was as an office boy in the general freight office of the Michigan Central in 1881. After serving in various minor positions he was appointed Assistant Superintendent of the Standard Foundry Company of Cleveland, Ohio, where he remained for a number of years. In 1903 he was appointed Auditor of the Pacific & Idaho Northern, and in May this year was promoted to be General Manager, having the additional title of Vice-President added the following month.

—Mr. J. S. Lawrence, whose promotion to be Superintendent of the Third District of the Canadian Pacific to succeed Mr. Busteed, was recently announced, was born in Toronto in 1863. His railroad service dates from 1879, when he began as a telegraph operator in the office of the Northern & Northwestern (Grand Trunk) at Collingwood, Ont. Two years later he was transferred to Barrie, where he remained one year. In 1882 he was appointed Relieving Agent, and at various times filled the agencies at Allandale, Barrie, Milton and other points. In June, 1886, he was made train despatcher at Allandale, but resigned about three months later to go to North Bend, B. C., where he held a similar position on the Canadian Pacific. In December, 1893, he was appointed Trainmaster at Nakusp for the Nakusp & Slocan Railway; then Trainmaster for the Columbia & Western. When, in 1902, the Kootenay sections were consolidated Mr. Lawrence went to Nelson as Trainmaster of the Canadian Pacific lines, from which position he is now promoted to be Superintendent of the same district.

—Mr. Gardner S. Williams, M. Am. Soc. C. E., and Professor of Experimental Hydraulics in charge of the Hydraulic Laboratory of Cornell University, has been appointed to the Chair in Engineering at the University of Michigan, made vacant by the death last fall of Prof. Charles E. Greene. Professor Williams was born at Saginaw, Mich., and entered the University of Michigan in 1884, graduating therefrom in the Civil Engineering course with the class of 1889 and taking the advanced degree of C. E.

in 1899. During portions of 1887, 1888 and 1889 he was engaged upon water-works construction at Bismarck, Dak., Greenville and Owosso, Mich., and in 1890 became engineer for the Russel Wheel and Foundry Company of Detroit. In 1893 he was appointed Civil Engineer to the Board of Water Commissioners of Detroit, and carried on the experiments on the flow of water in pipes, for which, with his collaborators, he received the Norman medal of the American Society of Civil Engineers in 1901. In 1898 he went to Cornell, where he has been since. Here he has been connected with many important hydraulic investigations, among them work for the United States Board of Engineers on deep water bays; on flow over dams; for the city of New York on the flow over the Croton dam and percolation through embankments; for the New York State Canal Survey on the measurement of water; and for the United States Geological Survey on similar subjects. He has also carried on an extensive consulting practice. Last fall he was appointed by President Roosevelt one of the representatives of the United States on the International Commission on Lake Levels and Navigation.

—Mr. Edward L. Janes, who resigned as Chief Clerk to the Superintendent of Motive

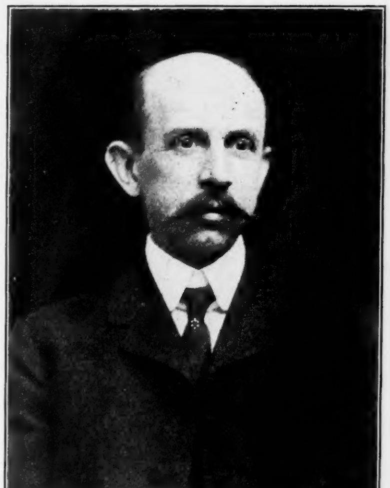


Power and Rolling Stock of the Boston & Albany to become New England representative at Boston for the American Brake Shoe & Foundry Company, was employed on that road for more than 27 years. He began as a record clerk in the office of the General Ticket Agent. In 1882 Mr. Janes was made chief clerk in the motive power department and, excepting a year and a half as secretary to the General Manager, served in a similar capacity until his retirement. Mr. Janes is Secretary of the New England Railroad Club, which position it is understood he will continue to fill.

—Mr. Charles H. Chappell, for many years Vice-President and General Manager of the Chicago & Alton, whose sudden death was announced in our issue of June 24, was a native of Illinois, and began his railroad service on the Chicago, Burlington & Quincy, at the age of 16, as brakeman. He remained with this company until 1869, serving as conductor, clerk in the Assistant Superintendent's office, Chief Train Despatcher, and Trainmaster. He resigned to become Division Superintendent on the Union Pacific. In 1871 he returned to the Burlington as Assistant Superintendent, but again resigned to go to the Missouri, Kansas & Texas, where he was Superintendent of Transportation. Then for a year he was on the St. Louis, Iron Mountain & Southern as Division Superintendent, and in 1876 was appointed Assistant General Superintendent of the Mis-

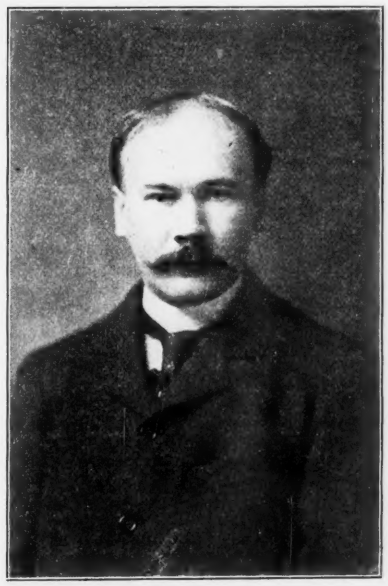
souri Pacific. From 1877 to 1880 he was Division Superintendent on the Texas & Pacific, and later on the Wabash, St. Louis & Pacific. In the latter year he went to the Chicago & Alton. For one year he was Assistant General Superintendent, then about six months was General Superintendent; two years Assistant General Manager, and for seven years from 1883 he was General Manager. In 1894 the title of Vice-President was added. Mr. Chappell retired from active service when the Harriman interests came into control, but he remained a director until his death. He was 63 years old.

—Mr. Dwight W. Pardee, who on Thursday of last week was chosen to succeed the late Mr. Worcester as Secretary of the New York Central & Hudson River, has for the past 20 years been Assistant Treasurer of the Lake Shore & Michigan Southern. He was born in Westfield, N. J., 52 years ago, and has been in railroad service since 1876.



He began as Secretary to the Treasurer of the Lake Shore. In 1879 he was elected Secretary and Treasurer of the Dunkirk, Allegheny Valley & Pittsburg and in 1884 was appointed Assistant Treasurer of the Lake Shore, which position he has since held. Mr. Pardee has also been elected Secretary of the Michigan Central and of the Indiana, Illinois & Iowa. Mr. Pardee's promotion is a recognition of a long period of exceptionally able and faithful service in the offices of the Vanderbilt system.

The accompanying portrait is that of Mr. Paul Morton, Second Vice-President of the Atchison, Topeka & Santa Fe, to whom President Roosevelt recently proffered a place in the Cabinet, as was noticed in the *Railroad Gazette* last week. On the 24th it was announced that Mr. Morton had been appointed Secretary of the Navy and had accepted the position. Mr. Morton is 47 years old and was born in Detroit, Mich. He is a son of the late J. Sterling Morton of Nebraska, former Secretary of Agriculture. Although having an opportunity to enter college he chose a business career, and at the age of 16 took a place as clerk in the land department of the Burlington road. In 1873 he was advanced to a position in the General Freight office at Plattsmouth, Neb., and in less than a year was transferred to the headquarters of the company in Chicago, where he was made a junior clerk. Four years later, on his 21st birthday, he was appointed Assistant General Freight Agent, and in 1886



was made General Passenger Agent. He remained with the Burlington until 1890, when he resigned to go into the coal and iron business, having been elected President of one of the largest mining organizations in Iowa and Illinois. In addition to this he was Vice-President of the Colorado Fuel & Iron Company. In 1895 he returned to the railroad field, being elected Second Vice-President of the Atchison, Topeka & Santa Fe, the position which he now leaves to enter the Cabinet.

ELECTIONS AND APPOINTMENTS.

Atchison, Topeka & Santa Fe.—F. M. Bisbee has been appointed Acting Engineer of the Western Grand Division, with headquarters at La Junta, Col., succeeding H. C. Phillips, temporarily assigned to other duties. Paul Morton, Second Vice-President, has resigned.

Atlantic Coast Line.—J. C. Higgins has been appointed Superintendent of the Jacksonville District, with headquarters at Jacksonville, Fla., succeeding the late Mr. Purdon.

Buffalo, Rochester & Pittsburg.—F. T. Hyndman, hitherto Master Mechanic at Du Bois, Pa., has been appointed Superintendent of Motive Power, succeeding C. E. Turner, resigned.

Cane Belt.—Oliver Snyder, hitherto Superintendent of Terminals of the Gulf, Colorado & Santa Fe, at Galveston, has been appointed Vice-President, General Manager and General Freight and Passenger Agent, of the C. B., with headquarters at Eagle Lake, Tex., succeeding W. T. Eldridge.

Cincinnati, Hamilton & Dayton.—M. D. Woodford, President, has resigned.

El Paso-Northeastern System.—E. Dawson has been appointed Superintendent of Motive Power and Machinery, with headquarters at Alamogordo, N. Mex., succeeding T. P. Barnes, resigned.

Gulf, Colorado & Santa Fe.—A. P. Hall, hitherto Trainmaster at Temple, Tex., has been appointed Superintendent of Terminals at Galveston, succeeding Oliver Snyder, resigned. (See Cane Belt.)

Indiana, Illinois & Iowa.—Dwight W. Pardee was, on June 23, elected Secretary to succeed E. D. Worcester, deceased; Charles F. Cox, Treasurer; E. V. W. Rossiter, Vice-President in charge of finances, and John Carstensen, Vice-President in charge of the accounting department.

Kanona & Prattsburgh.—E. Wheeler has been appointed Superintendent, with headquarters at Prattsburgh, N. Y.

Lake Superior & Ishpeming.—R. C. Young has been appointed Chief Engineer, with headquarters at Marquette, Mich., succeeding J. F. Deimling, resigned.

Louisville & Nashville.—Walker D. Hines, First Vice-President, has resigned, effective July 15. W. H. Anderson has been appointed Superintendent of the Kentucky Central Division, with headquarters at Paris, Ky., succeeding Lewis Hood, resigned.

Louisiana Western.—(See Morgan's Louisiana & Texas.

Michigan Central.—E. V. W. Rossiter has been elected Vice-President and Dwight W. Pardee, Secretary, both to succeed the late E. D. Worcester.

Morgan's Louisiana & Texas.—E. B. Cushing, hitherto Engineer of Maintenance of Way of the Texas & New Orleans, has been appointed General Superintendent of the M. L. & T. and the Louisiana Western, with headquarters at New Orleans.

National of Mexico.—J. W. Dean has been appointed Superintendent of Terminals at Mexico.

New York Central & Hudson River.—Dwight W. Pardee has been elected Secretary, to succeed the late E. D. Worcester. (See Indiana, Illinois & Iowa; also Michigan Central.)

New York, New Haven & Hartford.—Frank N. Hibbits, hitherto Consulting Mechanical Engineer of the Southern, has been appointed Mechanical Superintendent of the N. Y., N. H. & H., with headquarters at New Haven, succeeding John Henney, Superintendent of Motive Power, resigned.

Southern.—Frank N. Hibbits, Consulting Mechanical Engineer, has resigned. (See New York, New Haven & Hartford.)

Southern Pacific.—W. D. Cornish, Vice-President of the Union Pacific, has been elected Vice-President of the S. P., succeeding H. E. Huntington; and Marvin Hughitt has been chosen to succeed Edwin Hawley as a Director. C. H. Markham, General Manager, has been made Vice-President.

Tennessee Central.—G. A. Clark, General Manager, has been made Vice-President, succeeding N. C. Chapman, resigned.

Texas & New Orleans.—A. V. Kellogg, hitherto Engineer of Maintenance of Way and Structures on the Houston & Texas Central, has been appointed Engineer of Maintenance of Way of the T. & N. O., with headquarters at Houston, succeeding E. B. Cushing. (See Morgan's Louisiana & Texas.)

LOCOMOTIVE BUILDING.

Kates & Bok, 79 Wall street, are reported to be in the market for six locomotives for export service.

The Peabody Coal Co. is having one locomotive built at the Brooks Works of the American Locomotive Co.

The Chicago & Eastern Illinois, it is reported, is contemplating the purchase of from 40 to 50 locomotives.

The St. Louis, Troy & Eastern is having one locomotive built at the Richmond Works of the American Locomotive Co.

CAR BUILDING.

The Southern Iron Car Line is having 100 freights built by the Georgia Car Co.

Kates & Bok, 79 Wall street, are reported in the market for 20 cars for export to Cuba.

The Mesabe Southern is having 75 freight cars built by the Russell Wheel & Mfg. Co.

The Norfolk & Western is said to be contemplating the purchase of the following equipment: Six baggage and express cars, five baggage and mail cars, 600 box cars of 80,000 lbs. capacity and 200 hopper cars of 100,000 lbs. capacity.

BRIDGE BUILDING.

Albany, N. Y.—Bids are wanted July 5 by Henry A. VanAlstyne, State Engineer and Surveyor, for building a bridge over Great Sodus bay at Resort, Wayne County.

Algiers, La.—The Controller, it is reported, has been authorized to ask bids for building a viaduct at Newton street to cost about $40,000.

Atlanta, Ga.—The Bridge Committee is considering the bids recently opened for building the bridge at Edgewood avenue. The Council has appropriated $15,000 to start the work, which will be begun at once.

Boston, Mass.—Bids for the steel superstructure of the bridge over the railroad tracks at Shawmut avenue opened by City Engineer Jackson range from $11,598 to $15,266.

The Metropolitan Water & Sewerage Board has given the contract for building the masonry arch at West Boylston to F. A. McCauliff & Co., of Fitchburg, at their bid of $12,888. Other bids ranged from $14,820 to $20,861.

Bucyrus, Ohio.—Bids are wanted July 12 by the County Commissioners for building a bridge 120 ft. long to carry one track with 20-ft. roadway over the Sandusky River at Mary street, in Crawford County. J. I. Smith is County Auditor.

Burlington, N. J.—The Board of Chosen Freeholders has authorized the asking of bids July 2 for building a bridge over Assiscunk creek at Mitchell avenue. John J. Norcross is a member of the committee.

Chicago, Ill.—Bids are wanted July 20 by the U. S. Engineer office, 1637 Indiana avenue, for building four steel highway bridges over the Illinois and Mississippi canal. C. S. Riche is Captain of Engineers.

Bids are wanted July 13 by the Board of Trustees of the Sanitary District for the substructure and the superstructure of the bridge over the Chicago River at Twenty-second street. S. D. Griffin is Clerk.

Cincinnati, Ohio.—Bids are wanted July 11 by W. T. Perkins, City Auditor, for $300,000 of viaduct bonds.

Cologne, N. J.—Bids are wanted July 6 by the Board of Chosen Freeholders of Atlantic County for rebuilding three highway bridges. Frank Enderlin is Committee Chairman.

Danville, Pa.—The County Commissioners have plans ready for building the proposed highway bridge over the Susquehanna river between Danville and South Danville, to consist of seven pin-constructed steel truss spans, each 186 ft. 9 in. long and 40 ft. wide.

Elkhart, Ind.—Bids are wanted July 7 by the County Commissioners for building eight bridges in Elkhart County.

Ellisville, Miss.—The County Commissioners have bought eight second-hand steel bridges and will ask bids July 4 for erecting same. W. H. Bifkin is Clerk.

Hannibal, Mo.—Bids are wanted July 2 by J. N. Baskett, Mayor, for building two steel bridges. C. F. Shepherd is City Clerk.

Havre de Grace, Md.—The contract for the Pennsylvania Railroad's new bridge over the Susquehanna River at Havre de Grace has been let to the American Bridge Company and the Pennsylvania Steel Company. Each firm will build one-half the bridge. The new bridge is to be a double-track steel structure and will be longer than the one it replaces. The bridge will be located about 300 ft. north of the present one and will have a higher elevation.

Johnstown, Pa.—The plans made by City Engineer Lee Masterson for a highway bridge over the Pennsylvania tracks to connect Prospect with this place call for a steel structure 82 ft. long with a roadway of 24 ft., an 8-ft. sidewalk and approaches of steel about 400 ft. long.

Laporte, Ind.—Bids are wanted July 6 by the Board of County Commissioners for building an iron bridge in Pleasant Township, Laporte County.

Leavenworth, Kan.—Bids are wanted July 6 by M. A. Przybylowicz, County Clerk, for building a bridge over the north branch of Three-Mile creek on Shawnee street.

Little Rock, Ark.—Eleven bridges have been carried away by high floods in Wilson Township, Yell County.

Lockport, Ind.—Bids are wanted July 12 by the County Commissioners for two concrete bridges in Spencer County.

Morrilton, Ark.—Bids are wanted July 16 by J. C. Steele, County Judge, for building a steel bridge 176 ft. long.

Newcastle, Pa.—Bids are wanted July 5 by Lawrence County Commissioners for building a steel bridge 800 ft. long over Beaver River.

Oneida, N. Y.—The Common Council has authorized the Mayor to present a petition to the State Board of Railroad Commissioners asking for the elimination of grade crossings at Seneca avenue by the construction of a viaduct over the New York, Ontario & Western racks and Oneida creek.

Peoria, Ill.—Bids will be asked in about six weeks for building a steel bridge over the Illinois River at Bridge street; to be 2,400 ft. long and to cost about $300,000. H. E. Beasley is City Engineer.

Point Pleasant, W. Va.—Bids are wanted July 5 by J. P. R. B. Smith, Clerk of the County Court, for building a steel bridge over Eighteen-Mile creew near Ashton.

Port Arthur, Texas.—Jefferson County has issued $20,000 bonds to build a bridge over Taylor's bayou, near Port Arthur.

Portland, Ore.—The steel bridge over Union avenue is to have a total length of 420 ft. to consist of two Warren trusses each 120 ft., and plate girders, and the one at Grand avenue a total length of 360 ft., to

consist of one Warren truss of 150 ft. and plate girders. W. C. Elliott is City Engineer.

SALEM, MASS.—The Common Council has appropriated $12,000 to rebuild the North street bridge.

ST. AUGUSTINE, FLA.—The City Council has decided to build during the summer a steel bridge with stone abutments to replace the present wooden bridge over South street.

ST. PAUL, MINN.—The Board of Aldermen has passed a preliminary order authorizing the building of a steel bridge over the Northern Pacific tracks at Payne avenue and Beaumont street.

SCHENECTADY, N. Y.—The question of building a viaduct over Cotton Factory Hollow is being considered by the committee, to cost about $20,000.

SOBIESKI, WIS.—Bids are waned July 21 by J. J. Hof for building a concrete two-arch highway bridge over Little Suamico river in Oconto County.

WALLINGFORD, CONN.—The Consolidated Railway, it is reported, has given a contract to B. D. Pierce, Jr., of Bridgeport, at about $50,000 for building a concrete arch over Wharton Brook on the new Wallingford electric extension; also for a concrete arch under the tracks on the same extension and for some other work.

WICHITA, KAN.—Bids are wanted July 9 by the County Commissioners for building two steel bridges in Sedgwick County.

Other Structures.

ASHEVILLE, N. C.—The Southern Railway has plans ready and will build at once on the site of the present building a new passenger station to cost about $66,000.

BATON ROUGE, LA.—The Yazoo & Mississippi Valley, it is reported, is planning to remove the present station and put up a new one to cost about $30,000.

BATTLE CREEK, MICH.—The Grand Trunk, it is reported, has bought a large tract of ground on the outskirts of this place and will build locomotive shops in place of those at Port Huron. A new station is also talked of.

BUTTE, MONT.—The Great Northern, it is reported, is making plans to build a union passenger station.

EVANSTON, ILL.—The Chicago & Milwaukee Electric, the Chicago, Milwaukee & St. Paul Railroad, and the Northwestern Elevated, it is reported, have arranged to jointly build a large union station for the combined use of the three roads.

FREMONT, NEB.—The Chicago & North Western, it is reported, has decided to build large repair shops for the Nebraska Division here.

HAVELOCK, NEB.—The damage by fire to machinery in the Chicago, Burlington & Quincy shops June 21 amounts to about $65,000. The damage will be repaired as rapidly as possible.

ILLMO, MO.—The St. Louis Southwestern will build, with the company's forces, a brick roundhouse containing 21 stalls, with a 70-ft. turntable; also a station building 20x100 ft., of wood, and coal chute with 24 pockets.

LITTLE ROCK, ARK.—The Missouri Pacific, it is reported, has bought ground on which it will build a freight house and passenger station.

NORFOLK, VA.—The Norfolk & Western, it is reported, has instituted condemnation proceedings to secure land near Lambert's Point as a site for repair shops.

PHILADELPHIA, PA.—The Pennsylvania, it is reported, has bought land on Delaware avenue between Vine and Callowhill streets as a site for a large freight house.

SYRACUSE, N. Y.—The Rapid Transit Railroad Company, it is reported, will begin work about August 1 on its new car barn on Cortland avenue, and will later build an office building.

YOUNGSTOWN, OHIO.—The Baltimore & Ohio, it is reported, is making plans for building a new passenger station on Mahoning avenue.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ALEXANDRIA, MACON & GREENVILLE.—A charter has been granted to this company in Louisiana to build a railroad from Alexandria, La., northeast to Greenville, Miss., 150 miles. The headquarters of the company will be at Delhi, La. J. D. Garrison is Chief Engineer. It is stated that grading will be begun at once.

ATHENS & NORTHERN.—Incorporation has been granted this company in Ohio to build a railroad from Mineral, in Athens County, through Perry, Morgan and Muskingum counties to Zanesville, 45 miles. C. C. Guthrie, M. T. Reed, M. V. Burnside and others are incorporators. The headquarters of the company will be at Columbus, Ohio.

BAY MINETTE & FORT MORGAN.—A charter has been granted this company in Alabama to build a railroad from Bay Minette in a southerly direction through the county of Baldwin, for a distance of about 45 miles. T. P. Hamm is President and W. W. Olney, Vice-President, both of Bay Minette, Ala.

BLACK LICK & YELLOW CREEK.—This company has been incorporated in Pennsylvania to build a railroad from Rexie, in Indiana County, to Burns Summit, 10 miles. A. W. Lee, Clearville, Pa., is President.

BUCKHANNON & NORTHERN.—Press reports state that work will be resumed on July 1. This road, which is one of the connecting links between the West Virginia Central & Pittsburg and the Wabash, was originally located between New Brownsville, W. Va., and Bellingham, 85 miles. A length of about 30 miles was graded last year, but work was suspended in the fall. S. D. Brady, Parkersburg, W. Va., will be the engineer in charge. (See Construction Supplement.)

CHICAGO & MILWAUKEE (ELECTRIC).—Articles of incorporation have been filed by this company in Wisconsin. It is proposed to build an electric railroad from a point on the state line between Illinois and Wisconsine, near Pleasant Springs, Kenosha County, to Milwaukee, passing through the counties of Kenosha, Racine and Milwaukee. Albert C. Frost, Chicago, is said to have a controlling interest in the company.

CRAWFORD COUNTY MIDLAND.—A charter has been granted to this company in Missouri to build a railroad six miles long in Crawford County from a point on the St. Louis & San Francisco, near Steelville. W. K. Bixby, H. J. Hannibal and others are incorporators.

DENVER, NORTHWESTERN & PACIFIC.—A regular train service has been placed in operation on this line between Denver, Colo., and Monmouth, 47½ miles. Work is now in progress on a further extension of the line to Kremmling.

EDMONTON & SLAVE LAKE.—Plans have been filed by this company for the construction of a line north from Edmonton, Alberta, for a distance of 50 miles, passing through St. Albert. This line is reported to be a portion of the Canadian Northern system. H. H. MacLeod is Chief Engineer.

LONG ISLAND.—This company has purchased several acres of land in Long Island City, N. Y., for a large freight yard. The property acquired is an elliptical tract extending from a point east of Thompson avenue and the proposed Blackwell's Island Bridge plaza to Woodside avenue, a distance of about 1½ miles. The average width of the land is 2,500 ft.

LOUISIANA ROADS.—The Louisiana & Pacific and the De Ridder & Eastern Railroad Companies have been incorporated in Louisiana. Both are logging roads and are owned by the Long-Bell Lumber Co., of Kansas City.

MCRAE & DUBLIN.—This company is to be organized in Georgia to build a railroad from Dublin south to McRae, 25 miles. The road will connect with the Southern at McRae and with the Macon, Dublin & Savannah at Dublin. G. M. Wilcox, E. F. McRae, G. F. Holland, C. E. McRae and others, of Dublin, Ga., are interested.

NATURAL BRIDGE R. R.—An officer writes that about six miles of track have been laid on this railroad east from Moody, Fla. The line is being built to Wacissa, 15 miles, where connection will be made with the Tallahassee Southwestern. The work is being done by the company's forces and includes a large bridge over the St. Marks river. F. W. Boatright, Moultrie, Ga., is General Manager. (June 17, p. 7.)

NEW HOPE VALLEY.—An officer writes that the proposed route of this road is from New Hill, N. C., to a point near Chappel Hill, about 20 miles. Contracts for grading will shortly be let. William Montcure, Raleigh, N. C., is President. (June 24, p. 15.)

NEW MEXICO MIDLAND.—This company has been incorporated in New Mexico to build a railroad 15 miles long to connect with coal fields near Carthage. H. M. Dougherty, Socorro, N. Mex., is interested.

NEW YORK CENTRAL & HUDSON RIVER.—Press reports state that this company has acquired an extensive tract of land between Buffalo and Tonawanda, which will be used for terminal facilities. The property lies between the Niagara Falls branch of the Central and the river front.

NEW YORK CONNECTING.—The New York City Rapid Transit Commission has granted this company a franchise to build a viaduct railroad through Long Island City to the East river at a point opposite Ward's Island and thence by means of a bridge to pass across Ward's and Randall's Islands to a connection with the New York, New Haven & Hartford. The proposed railroad is to be built chiefly for transferring freight cars from the Pennsylvania at Greenville, N. J., (by ferry to Bay Ridge and then over the Long Island Railroad) to the New York, New Haven & Hartford; but the franchise also permits the running of passenger trains, and there will be a connection with the East River tunnel. The capital stock is held jointly by the Pennsylvania and the N. Y., N. H. & H. companies. The line will run on a viaduct carried over the intersecting streets at a sufficient height so that it will not interfere with street traffic, and will be built on private right of way.

OMAHA & NEBRASKA CENTRAL.—Articles of incorporation have been filed by this company in Nebraska with an authorized capital stock of $11,500,000. The proposed route is from Omaha to Hastings, Neb., 155 miles. C. J. Helm and Anthony Texter are incorporators. The headquarters of the company will be at Lincoln, Neb.

PENNSYLVANIA.—An appropriation of $500,000 has been made by the directors to enlarge the passenger yard near the Union Station at Pittsburg. The ground to be improved has heretofore been used for freight, but the completion of the Brilliant cut-off relieves the pressure of freight and makes possible the enlargement of the passenger facilities.

PITTSBURG & WESTMORELAND.—A charter has been granted to this company in Pennsylvania to build a railroad five miles long from North Huntingdon, in Westmoreland County, to Herminie. E. B. Irwin, Harrisburg, Pa., is President.

St. Louis & San Francisco.—The Supreme Court of New York has vacated the temporary injunction which was granted, on the suit of Kissel, to restrain the issue of bonds amounting to $16,000,000 recently proposed. The injunction was claimed on the ground that the contract, by which the S. L. & S. F., acting for the C. & E. I., agreed to guarantee traffic to the St. Louis, Memphis & Southeastern, was an unfair diversion of money, impairing the ability of the Chicago & Eastern Illinois to pay dividends on its stock. The vacating of the injunction removes the obstacles in the way of carrying out the plant adopted some time ago to retire $33,540,500 securities of the St. Louis, Memphis & Southeastern and the St. Louis & Gulf and to issue $21,000,000 new securities. The plan further called for the immediate issue of $16,000,000 first mortgage 5-year 4½ per cent. bonds on the entire property of these two railroad companies, the bonds being guaranteed, both as to principal and interest, by the St. Louis & San Francisco.

St. Louis, Little Rock & Gulf.—An officer writes that a contract has been let to Donald Grant & Co., of Faribault, Minn., for building the first section of this road from Little Rock to Sheridan, Ark., about 40 miles. The character of the work is light, with a maximum grade of 1 per cent. and a maximum curvature of 2 deg. There will be 10 steel bridges on the line. The road is proposed eventually to run from Little Rock to Port Arthur, Texas, about 700 miles. H. S. Shaner, Little Rock, Ark., is President, and H. H. Fielder is Chief Engineer. (June 17, p. 7.)

St. Louis, Webster & Valley Park.—This company has been chartered in Missouri to build a railroad from St. Louis to Valley Park, all in St. Louis County. S. S. Wallace, William Buckley and others are incorporators.

San Antonio & Eastern.—Articles of incorporation have been filed by this company in New Mexico. It is proposed to build a railroad from San Antonio to coal fields near Carthage, 12 miles. J. T. Fitch, S. P. Allen, W. W. Allen and others, of Kansas City, are incorporators.

South Dakota Central.—According to press reports, this road, which is now being built between Sioux Falls and Colton, S. Dak., will be completed as far as Madison by August 1. It is proposed eventually to extend the road to Watertown, S. Dak. P. F. Sherman, Sioux Falls, S. Dak., is President. (April 22, p. 314.)

Southern.—A contract has been awarded to W. J. Oliver & Co. for building a cut-off from Danville, Ky., north to Harrodsburg, 10 miles. Connection will be made with the C., N., O. & T. P. at Harrodsburg.

Sunnyside Railroad.—Articles of incorporation have been filed by this company in the state of Washington. It is proposed to build a railroad from Toppenish, Wash., on the Northern Pacific, in a southeasterly direction to Sunnyside and thence to a point near Prosser, 30 miles. F. H. Gloyd and F. L. Pitman, of Prosser, Wash., and C. E. Woods and S. J. Harrison, of Sunnyside, are incorporators.

Wellsburg & Buffalo Valley.—This company has been chartered in New Jersey with an authorized capital of $1,000,000. It is the purpose of the company to build and equip railroads. A. E. Anderson, E. F. Hubbard and others, of Jersey City, are named as incorporators.

RAILROAD CORPORATION NEWS.

Canada Eastern.—The Cabinet of the Dominion Government has voted to buy this railroad, which runs from Chatham to Gibbs, 127 miles, with a branch line nine miles long. It will be operated as a part of the Intercolonial. Before the purchase can go into effect, however, the proposition must be ratified by the Dominion Government.

Canada Southern.—At a recent meeting of the directors of this company, a semi-annual dividend of 1¼ per cent. was declared. This is an increase of ¼ per cent. as compared with the corresponding period of last year. This dividend is the first which has been declared under the new lease that went into effect on January 1 of this year. This lease provides that the Michigan Central shall pay 2½ per cent. annual dividends on the Canada Southern stock until 1910, after which the rate shall be 3 per cent. for the remaining period of the 999-year lease.

Detroit & Toledo Shore Line.—Moore, Baker & Co., Boston, are offering at 87½ and interest $300,000 of this company's first-mortgage bonds. A circular says in part: "The road extends from Manhattan Junction, Toledo, to Delray, a suburb of Detroit, 48 miles, of which 20 miles is double track and the whole laid with 80-lb. rails. The terminals at Toledo are those of the Toledo Railway & Terminal Co., which are used jointly by this road and the Pennsylvania, the Pere Marquette, the Ann Arbor and the Wheeling & Lake Erie. From Delray the Detroit & Toledo Shore Line has a trackage agreement with the Wabash by which it connects with the Grand Trunk in Detroit." The principal and interest of these bonds are guaranteed jointly by the Grand Trunk and the Toledo, St. Louis & Western.

Erie.—The report of this company for May shows gross earnings of $1,503,191, a decrease of $304,913 over May, 1903. For the eleven months ending May 31, 1904, the gross earnings were $41,108,530, a decrease of $327,954. Operating expenses during this period increased $3,025,947, leaving a decrease in net earnings of $3,353,901.

Lehigh Valley.—At a meeting of the directors on June 29 a dividend of 1 per cent. was declared on the common stock of this company. This is the first dividend which has been paid on the common stock for 11 years, the last payment being 4 per cent. in 1893. A dividend of 10 per cent. has also been declared on the preferred stock of the company, of which there is $106,300 outstanding. This dividend of 10 per cent. was made necessary owing to the proviso that the holders of the common stock should receive nothing until 10 per cent. per annum was paid on the preferred stock.

Michigan Central.—A suit has been brought against this railroad by the State of Michigan to recover $4,050,450 in taxes which the State claims is due to it on account of alleged false statements made by the railroad company's officials. The complainant charges that since 1854 the officials of the company have not made accurate reports on the capital stock paid in and on the loans made for the purpose of construction. The act creating the Michigan Central Railroad provides that the road shall pay the State a stipulated annual tax on all capital stock paid in and on loans.

Southern Pacific.—A circular has been issued by President E. H. Harriman to the stockholders of the company extending until July 28 the time for receiving subscriptions to the proposed issue of $40,000,000 preferred stock. It is stated that this extension of time is for the purpose of allowing the European stockholders to take advantage of the opportunity to subscribe to the new issue.

Wabash.—The directors of this company have passed the usual semi-annual dividend of 3 per cent. on the debenture A bonds. Interest has been paid continuously on these bond for 11 years. It is said that the passing of the dividend is due to a falling off in earnings and to large appropriations for betterments. Over two-thirds of these bonds are owned by Russell Sage and George Gould.

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CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

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